National Institute for Occupational Safety and Health
NIOSH

NIOSH CBRN SCBA Users Guide

(Review # 04031)

"Date of Publication"

NIOSH CBRN SCBA Users Guide

2004

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Centers for Disease Control and Prevention
National Institute of Occupational Safety and Health
National Personal Protective Technology Laboratory

December 2004

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DHHS (NIOSH) Publication No. 2005-XXX

DIRECTOR'S FOREWORD

Chemical, biological, radiological and nuclear weapons, used by terrorists or other entities hostile to the United States, are a threat to the workers of this nation. Occupational safety and health requirements for emergency responders exposed to actual CBRN agents are expected to vary depending on type of weapon employed, weather conditions, structural integrity of buildings in targeted areas, concentration of CBRN agents, sampling and detection plans, available personal protective equipment, training level of responders, characterization of the crime scene, mitigation, containment and presence of any secondary or tertiary CBRN or explosive weapons. CBRN self-contained breathing apparatus can provide minimum respiratory protection against these agents, however, responders at the site may not have all or only partial information necessary to select the type of personal protective equipment appropriate for the response. In the cases where it is an initial response to a suspected CBRN terrorism incident, an actual CBRN incident or a follow on response to a known CBRN incident, open-circuit, pressure demand, self-contained breathing apparatus with CBRN protection approval are recommended. This use guide provides recommended actions and guidance for clearly identifying, using and disposing CBRN SCBA.

The purpose of the guide is to help individual respirator wearers, teams and leaders. It provides pointers for assessing SCBA for CBRN compliance, preparing respirators for CBRN response, using CBRN respirators in potential or known CBRN incidents and discarding contaminated CBRN respirators in post incident responses. Respirator program administrators may find this use guide helpful, however, the intended audience is the lowest level of end user. CBRN SCBA, when contaminated with G-series, V-series, H-series or L chemical warfare nerve or blister agents, are single use respirators and have a maximum of six (6) continuous hours of use life. Remaining types of contamination from Toxic Industrial Chemicals, routine fire debris, blood borne pathogens and biological or radiological particulate are treated in accordance with user instructions and traditional methods in place. Currently, on site detection methodologies to characterize a CBRN incident offer qualitative indicators of CBRN agent type and therefore, all or select exposure limits in a CBRN incident response are expected to be not known initially.

The guide is not intended to be used without a complete risk assessment involving all types of personal protective equipment capable of protecting against dermal, vapor and particulate CBRN exposures. Terrorism events may or may not involve chemicals that can quickly permeate or penetrate respirator materials and other equipment materials. Likewise these events may have extremely low toxic exposure levels that are difficult to measure. Actions before, during and after a chemical, biological, radiological or nuclear incident require pre-planning and are incident dependent, in that each response may require initial similar actions in route to the site, but once on site, actions done to contain, mitigate, evaluate, decontaminate and close may vary by the type of agent present. The NIOSH CBRN SCBA provides the highest known level of respiratory protection for these events. Proper use of the CBRN SCBA will assure maximum benefit to the user and contribute to sound occupational safety measures in the terrorism scene.

John Howard, MD, or Richard Metzler Signature Blocks

Acknowledgements

NIOSH expresses gratitude to the following personnel: Heinz Ahlers, Nancy Bollinger, Les Boord, Don Campbell, Maryann D'Alessandro, Brent Doney, Matt Gillen, Richard W. Niemeier, Eugene R. Kennedy,Terry Thornton, William Newcomb, William Haskell, Michael Kreuger and Nadia El-Ayouby for their technical support review comments or managerial guidance. NIOSH also thanks the external reviewers for their comments and specifically, Mr. Carlton Kempter of the EPA.

A special thanks to Peter Bellina and Mr. Adrian Larry for their editorial review.

Photographs are courtesy of Globe Manufacturing, Interspiro Inc., Scott Health and Safety, Survivair Inc. and Mine Safety Appliances.

A final note of appreciation and dedication is expressed in the name of the late Mr. John M. Dower for his steadfast resolve, innovative scientific method analysis and overall support for advancing NIOSH chemical, biological, radiological and nuclear respirator technology development, policy interpretation and certification vision.

CONTENTS

NIOSH Recommended Guidelines for the Use of Chemical, Biological, Radiological and Nuclear (CBRN) Protected Open Circuit, Pressure Demand, Self-Contained Breathing Apparatus (SCBA) (NIOSH CBRN SCBA Users Guide)

Executive Summary

The National Institute for Occupational Safety and Health (NIOSH), National Personal Protective Technology Laboratory (NPPTL) certifies open circuit, pressure demand, self-contained breathing apparatus (SCBA) respirator for approved use by emergency responders and other qualified individuals reacting to emergency events involving chemical, biological, radiological or nuclear (CBRN) agents and effects. For more information related to equipment standards go to http://www.dhs.gov/dhspublic/interapp/editorial/editorial_0420.xml 2Dec04.

NIOSH is a division of the Centers for Disease Control and Prevention (CDC), United States Department of Health and Human Services. A NIOSH CBRN protection approval signifies that an SCBA is certified by NIOSH to provide respiratory protection against CBRN agents.

Additionally, the CBRN SCBA undergoes a compliance review by the Safety Equipment Institute in accordance with the National Fire Protection Association (NFPA) 1981, consensus document for protection against structural fire hazards. The CBRN SCBA approval requirements are designed to meet the consensus respiratory protection needs of emergency responders. NIOSH published a CBRN SCBA certification standard under 42CFR84, paragraph 84.63, (c) on December 28, 2001. On February 26, 2004, the U.S. Department of Homeland Security (DHS) adopted the first civilian homeland security standards on personal protective equipment for first responders and consequently, endorsed the use of NIOSH CBRN SCBA, NIOSH CBRN APR and NIOSH CBRN APER technical evaluation and certification standards along with five other NFPA protective equipment documents. DHS made the standards qualifying criteria for processing homeland security equipment preparedness grants. NIOSH CBRN SCBA approval letters are based on documented passing minimum laboratory results, rigorous tests and from stringent evaluation of manufacturer quality-control practices, technical specifications, and supporting documentation. This users guide presents accumulated information from that CBRN SCBA certification process, end user comments and practical use as it relates to real world experience against chemical warfare agents in controlled live agent centers such as the Center for Domestic Preparedness, ambient desert operations, Bldg E-5100 ECBC, 400-hours of CS, PEG 200 and iso-amyl acetate ground and aerial employment training operations, 1000-man hours in protective equipment/Level C, B and A, combat experience in Iraq and Saudi Arabia and intelligence preparation of the current terrorist battlefield. The users guide is even more relevant due to recent discovers in Fallujah, Iraq, 26November2004. Reports show clandestine chemical laboratory operations inside a building coupled with improvised explosive device production by insurgents [Combined Press Information Center, 2004]. SCBA

were used by local military personnel in assessing the insurgent laboratory. Donning a CBRN SCBA on quickly and having it correctly worn will prevent respiratory exposures to ambient concentrations of CBRN agents under even the most extreme conditions of confined or enclosed space. This guide will assist the user in determining what a respirator user needs to know regarding CBRN SCBA approval compliance, CBRN SCBA use and CBRN SCBA cautions and limitations of use.

List of Current Approvals

A list of approved CBRN SCBA is at http://www.cdc.gov/niosh/npptl/topics/respirators/cbrnapproved/scba/, 12Nov04.

Projected Approvals

Over the course of the next three years, NIOSH expects to provide respirator manufacturers the opportunity to have various classes of CBRN respirators approved and support manufacturers offering end users a greater variety of respirators for different types of potential CBRN respiratory occupational workplace needs. NIOSH continues processing CBRN SCBA applications in the technical certification (TC-13F) self-contained breathing apparatus respirator schedule. A CBRN closed circuit SCBA concept paper is published as of October 30, 2004. Future CBRN concepts for combination open circuit, SCBA with switch over capabilities from supplied air to purified air are projected. For more information on future projected new types of CBRN respirators go to the following links: http://www.cdc.gov/niosh/npptl/standardsdev/cbrn/scba/cc-scba/concepts/cc-scbacon103004.html and http://www.cdc.gov/niosh/npptl/standardsdev/cbrn/papr/

Intentions for Use

NIOSH CBRN SCBA respirators are intended for use by trained emergency responders for specific entry into or escape from unknown, known, suspected or partially characterized hazards. A hazard is defined by OSHA as the inherent capacity of a substance to cause an adverse effect [OSHA, 2003]. Emergency responders could respond to single, multiple or combined CBRN hazards. Safe incident response recommends or mandates the use of appropriate personal protective equipment. CBRN SCBA respirators are part of that PPE selection. At a CBRN emergency response hazardous event, respirators providing the highest level of protection should initially be used, and routinely used as the mission dictates, until hazard types and concentrations are quantified and exposures are determined to be at acceptable lower levels to allow downgrading or non use respiratory protection. Currently, the respirator configuration that offers the highest level of respiratory protection and inherent facial dermal protection is the NIOSH CBRN approved open circuit, pressure demand; SCBA First responders use CBRN SCBA in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazards. In support of providing

CBRN PPE selection matrix guidance based on toxicological exposure limits, a joint OSHA and NIOSH interim guidance that defines red, yellow and green zones and provides PPE recommendations for each zone is available at: http://www.osha.gov/SLTC/emergencypreparedness/cbrnmatrix/index.html.

Figure 1. Law enforcement CBRN emergency response team (ERT), circa 2000. Courtesy of Scott Health and Safety.

Use Life

The purpose of creating a "Use Life" practice for CBRN SCBA is to provide a guidance tool to properly distinguish actual use from more common SCBA terms such as rated service time and service life. Use life incorporates the known rated service times and service life and overlays the NIOSH CBRN SCBA cautions and limitations to generate a use life guidance that provides maximum protection to the end user from the permeating and penetrating effects of chemical warfare agents on SCBA. Use life assists in defining how long an contaminated CBRN SCBA can be used, while it is contaminated or assessed as potentially contaminated and when discarded it due to confirmed contamination presence. A CBRN SCBA could be discarded when a component is found contaminated and components such as facepieces, head harnesses, seals or hoses are altered due to exposure.

Use life is based on understanding and implementing the NIOSH cautions and limitations stated in the specific CBRN SCBA approval. An approved CBRN SCBA has 10 NIOSH required cautions and limitations applicable to the approved SCBA. They are lettered rather than numbered because the letters follow traditional NIOSH alphabetical listings already in existence plus new letters

assigned at the time the CBRN respirator statement of standard is issued. In the CBRN SCBA case, the cautions and limitations are I, J, M, N, O, S, Q, R, T and U. Of the 10, 4 cautions and limitations (Q, R, T & U) are new and specifically for CBRN incident response. These cautions and limitations are required to be published as a paper insert to the user instructions of the SCBA. All 10 cautions and limitation sentences and paragraphs are designed to ensure that maximum safety is provided to the end user. In the process of using those cautions and limitations, a use life plan for a contaminated CBRN SCBA can be developed by on scene commanders to aid in the determination of when and how to discard contaminated CBRN SCBA.

A unique use life practice for a continuous 6-hour period beginning at the time of a confirmed exposure to chemical warfare agents applies to the NIOSH CBRN SCBA only, since they are the only SCBA that have disposal recommendations in the approved NIOSH cautions and limitations. Some variations on this concept practice are possible. However, confirmed chemical warfare agent (CWA) contamination consisting of the nerve and blister agents only is the key to determining the 6-hour start point of the use life of a CBRN SCBA. Therefore, calibrated instruments which are designed to detect with redundancy, selectivity and repeatability, at known limits of detection, should be available for use on or remote to the terrorism site. If they are not available, controlled sampling procedures may provide methodologies to transport the samples to designated laboratories. These laboratories can then generate quantifiable results detailing the presence of confirmed CBRN contamination or the lack of it. Once detection monitoring qualifies the site and a qualified public health laboratory confirms the agent type and quantity present, the CBRN SCBA use life of 6 hours starts. With time delays in gaining the public health laboratory findings, the use life start point for a contaminated SCBA will likely require backward or forward time adjustment.

Use beyond the 6.0 hour mark in a confirmed chemical warfare agent incident violates NIOSH Caution and Limitation "U". However, in a real world use, the incident commander may be confronted with the decision to implement use beyond the 6.0 hour mark due to extenuating circumstances. For example, the need to rescue and recover victims combined with a shortage of clean CBRN SCBA might be one example of the need to re-use vapor only exposed CBRN SCBA. The incident commander should determine at the 5.5 hour mark of a 6.0 hour CBRN SCBA use life plan, if the possibility of chemical warfare agent permeation or penetration is significant or if it has been negated by immediate and/or technical gross decontamination techniques conducted and sample contamination confirmed by competent public or federal health laboratories. Examples of information links concerning emergency preparedness of public health laboratories: http://www.bt.cdc.gov/lrn/chemical.asp and http://www.aphl.org/Emergency_Preparedness/index.cfm, 12Nov04.

Decontamination operations may maintain use life, not increase it, if done expediently, however, accurate detection is vital to isolating a specific contaminated number of respirators as opposed to isolating the entire shift of responder used respirators that might or might not have been contaminated above an available permissible exposure limit or other recognized occupational exposure limit for the given contaminant or contaminants. Since sulfur mustard (HD) agent toxicology and effects are highly persistent, modifications of the 6-Hour use statement in caution and limitation U is not recommended and therefore, not permitted. Rapid decontamination techniques involving physical removal of HD contamination will decrease agent concentration relative to agent contact time. However, the use life of a CBRN SCBA means **six continuous hours in a single shift, day, or event.** Therefore, the use life of a CBRN SCBA is not 6 individual 1-hour exposures in one shift or one day, nor does is it 6 different 1-hour exposures over the course of 6 different days. None of these variations apply and any other variations presented at the time of the incident response will also not apply if they deviate from the central use life theme focused on maintaining NIOSH CBRN protection approval.

User Guidance: Before, During and After Operations

Emergency responders, trained and proficient in life saving measures, structure collapse response, environmental preservation and property assessment, routinely conduct pre-checks, in-process checks and post-checks of all issued and collective equipment used in route, on scene and off site. In an effort to categorize these actions into a user-friendly format relative to CBRN agent responses, information is outlined in this guide as before, during and after operations actions. This is recommended guidance to better support end user understanding, provide a written source for training purposes and a format for future guidance updates. Manufacturer's user instructions published at the time of issue of the CBRN SCBA have been utilized in the development of this guidance. This joint perspective has resulted in tailored specific guidelines describing CBRN SCBA use before operations, during operations, and after operations while integrating pertinent NIOSH CBRN SCBA cautions and limitations. All use actions for CBRN SCBA are centered on the 4 facts that once contaminated, 1) CBRN SCBA are single use, 2) have a maximum of 6.0 continuous hours of use life, 3) are decontaminated as expediently as possible to prevent the spread or penetration of contamination to other personnel or equipment and 4) all direct contact with CBRN agents require proper handling of the SCBA after each use and between multiple entries during the same use. Decontamination processes based on adjusted bleach pH have been demonstrated by the EPA as providing up to 6 logs of kill for biological agents with sufficient residence time on porous or hard surfaces. Methodologies for decontamination of select chemical warfare agents are also being formulated by the EPA. See the following links for additional information concerning adjusted bleach pH decontamination:
http://www.fema.gov/txt/areyouready/areyouready.txt

http://ehp.niehs.nih.gov/members/1999/107p933-974munro/munro-3.html

http://www.epa.gov/etv/verifications/testqa-index.html#bdt, 10Nov2004.

CBRN SCBA Integration with Suit Ensembles

Protective suit ensembles used in hazardous waste operations (HAZWOPER) and commonly known as EPA Levels A, B, C and D are accepted by OSHA to provide increasing levels of dermal and respiratory protection from liquid, aerosol and particulate CBRN contaminates. Levels A and B, provide higher levels of respiratory protection since the SCBA is used, than levels C and D. CBRN SCBA can be worn in Levels A or B. Crisis incident commanders may weigh the mission risk and opt to use CBRN SCBA in Level C for a specific response because Level A or B might be to cumbersome or responders may not have Level A or B immediately available for crime scene management or life saving response. CBRN SCBA is designed by manufacturers to provide respiratory protection with or without protective suit ensembles. CBRN SCBA are approved as stand alone respiratory protection devices and not in tandem with any protective suit ensemble or suit sub-component.

Use of CBRN SCBA and non-CBRN SCBA respirators with firefighter turn out gear, law enforcement field gear, EPA Level A, B, C and D ensembles, NFPA 1994 Chemical/Biological Terrorism Incident class 1, 2 or 3 ensembles or any other dermal protective barrier recognized through the U.S. Department of Homeland Security, by an incident commander or unified commander, depends on the environmental conditions of the site, whether the CBRN agent is unknown or known and whether the agent concentration can be characterized. What to use, when to use it, how to use it and why use it are the types of use questions for a national response to a CBRN terrorism incident. Currently, respirator manufacturers outfit SCBA with compatible accessories such as pass thru devices that support SCBA compatibility with protective suit ensembles and portable air sources. CBRN SCBA are equipped with Rapid Intervention Team (Crew)/Universal Air Connection accessories that support SCBA compatibility with protective suit ensembles and portable air sources. Use of the RIT/UAC or Pass Thru device in an actual CBRN contaminated atmosphere is at the discretion of the incident commander or lead federal agency officer in charge.

Future Generation Concepts

Several other types of respirators are available from manufacturers to gain NIOSH CBRN protection approval. They include the tight fitting, full-facepiece air-purifying respirators (APR) for emergency responders, a self-contained escape respirator (SCER) and air-purifying escape respirators (APER) for use by the general working populations. Anticipated future respirator approvals will include the CBRN powered air-purifying respirator (PAPR), CBRN closed circuit SCBA and CBRN combination SCBA/air-purifying respirators. NIOSH is continuing its efforts in publishing CBRN use guides and intends to generate peer reviewed

documents pertaining to various classes of CBRN approved respirators. The guides will utilize NIOSH public statement of standards as technical performance references.

Chapter 1. Background

a. Purpose

The purpose of this document is to provide users with practical guidance for the proper use of a specific type of SCBA, which have been approved by NIOSH for protection against CBRN agents. While select portions are ideal for respirator protection program administrators, the intent of the guide is to assist emergency responders in identifying, maintaining, using and integrating open circuit, pressure demand SCBA, also known as Breathing Apparatus (BA), that have NIOSH CBRN protection approval. A use guide intended to be shared and updated as real world events allow and as technology advances.

Proper use of a respirator is a complex process requiring the knowledge of how to properly select a respirator for a specific contaminant or environment, assuring its proper fit, and being aware of protection limitations. The information in this guide is intended to be administered through a complete respiratory protection program under the Occupational Safety and Health Administration (OSHA) Respiratory Protection Standard [29 CFR 1910.134]. The respirator protection program covers criteria for selecting respirators; medical evaluations; fit testing; use; maintenance, inspection, breathing air quality, cleaning, and storage; worker training; program logistics; and regular evaluations of program effectiveness. The respiratory protection program is directed by a designated knowledgeable professional (competent person), the respirator program administrator. The respirator program administrator oversees all aspects of the respirator program, interacts with management personnel and is available to the user as a resource for questions or concerns on respirator use. The guide is subject to continual review and update when facts change due to technology improvements or real-world event characterization. While the guide is ideal for end users, as stated, it does contain elements that are ideally well suited for respirator protection program administrators to consider.

Information on the OSHA Respiratory Protection Standard [29 CFR 1910.134] is available at:

http://www.osha.gov/SLTC/etools/respiratory/index.html

b. Inter-Agency Agreement

In 1999, a user-working group supported by voluntary participation from various local, state, federal government and private organizations was formed. Its name is the InterAgency Board for Equipment Standardization and Interoperability (IAB) Working Group. Per the IAB 2003 Annual Report and 2004 Standardized

Equipment List publication, the IAB mission is to establish and coordinate local, state and federal standardization, interoperability and responder safety to prepare for, respond to, mitigate from and recover from any CBRN incident by identifying requirements for chemical, biological, radiological, nuclear or explosives (CBRNE) incident response equipment.[26]

In 1999, the IAB supported the need for the development of federal standards or guidelines for personnel protective equipment with respiratory protection equipment as one of the top priorities. In response to this 1999 initiative, the National Institute for Standards and Technology (NIST), NFPA, NIOSH and OSHA entered into a memorandum of understanding defining each agency's or organization's role in developing, establishing, and enforcing standards or guidelines for responders' respiratory protective devices. In 2001, the Centers for Disease Control and Prevention (CDC) and NIOSH entered into an Inter-agency Agreement (IA 02-03) with the United States Army, Soldier, Biological Chemical Command (SBCCOM), which has since been redesignated the Research, Development and Engineering Command (RDECOM). IA 02-03, entitled Testing Activities to Support Respirator Standards Development and Approval Testing, required NIOSH to collaborate with SBCCOM on the establishment of test procedures for various classes of respirators for use by first responders to incidents of terrorism, provide SBCCOM standard test procedures and reimburse SBCCOM for costs of conducting laboratory tests. In return, SBCCOM provides laboratory testing and administrative services for performance of laboratory tests requested by NIOSH/NPPTL using NIOSH standard test procedures, SBCCOM assures that SBCCOM laboratory practices are documented and followed, provide NIOSH test reports for all required tests and collaborate with NIOSH on the establishment of test procedures for various classes of respirators for use by first responders to incidents of terrorism. The collaborative standards development and research efforts of IA 02-03 resulted in the first NIOSH CBRN SCBA certification standard, dated December 28, 2001, the ongoing CBRN SCBA certification program and the CBRN SCBA upgrade kit certification program. Information related to the CBRN SCBA standard and CBRN SCBA upgrade/retrofit kit letter is located at the following links:

http://www.cdc.gov/niosh/npptl/standardsdev/cbrn/scba/ 15Nov04
http://www.cdc.gov/niosh/npptl/resources/pressrel/letters/lttr-031103c.html

Chapter 2. Design Requirements and Components

a. Standard Development and Analysis

To determine the certification testing criteria for the CBRN SCBA, the following areas were defined and reviewed. First, an SCBA market survey of current SCBA technology was conducted by NIOSH with the support of the International Safety Equipment Association (ISEA). The survey resulted in NIOSH bench testing all available industrial rated NIOSH approved NFPA compliant SCBA against existing SBCCOM GB and HD respirator mounted head form test protocols in existence at Edgewood Chemical Biological Center. Second, a NIOSH policy review determined

the applicability of current 42CFR Part 84 paragraphs and how NIOSH was authorized to implement new CBRN SCBA certification testing by policy, as opposed to rule making. Third, simultaneously, a hazard assessment of possible CWA incidents and physical hazards was collaborated and defined with SBCCOM while a corresponding analysis of human factor and CBRN special test protection requirements were written and NIOSH standard test procedures developed and verified.

The joint CBRN hazard assessment considered physical chemistry characteristics and use of available terrorism venue modeling techniques to generate contamination concentration profiles about the potential hazards at an incident involving CWAs. For these assessments, the means of delivery and dissemination of the CWA were considered, combined with other variables including the amount of CWA employed and the environmental and physical characteristics of the area where the incident may occur. This threat analysis led to the final development of defined special test toxicology Airborne Exposure Guideline Level (AEGL) values, incorporation of those values for test requirements and resultant pass/fail criteria of the CBRN SCBA under test.

Coupling the threat analysis with the policy definitions of 42CFR Part 84 applicable sub-paragraphs and the fire safety compliance inspection of the testing laboratories of the NFPA, NIOSH generated a CBRN SCBA certification standard that revolutionized the SCBA industry and demonstrated that respirator manufacturers were able to achieve a higher standard of protection for the users of SCBA in the form of a NIOSH Approved CBRN SCBA. A CBRN SCBA that has approval under 42CFR Part 84, NFPA 1981 compliance review and NIOSH special CBRN tests approval, results in a device that provides a higher degree of inhalation protection against a multitude of hazards while using current available technology. The adoption of the three compliance testing approach became known as the "Three-Tier Approval Process"

1) Three-Tier Approval Process

NIOSH established the enhanced performance and design requirements for certification as a three-tier approval program designed to meet the identified respiratory protection needs, current environmental use conditions of emergency responders and predicted civilian hazard exposures based on a variety of exposure scenarios ranging from open air to confined space. Confined space was determined as the worst case scenario with the possibility of concentrated chemical warfare compounds, lower explosive limits (LEL), varying oxygen levels and displaced oxygen concentrations.

- Tier 1— Industrial approval for the program ensures the SCBA meets current NIOSH approval requirements for an SCBA under NIOSH 42 CFR part 84, Subpart H. The CBRN SCBA certification program utilizes the vast amount of experience NIOSH has in approving technical certification number 13F

approvals in the occupational workplace under NIOSH 42CFR84, Subparts H and L. Tier 1, or the first tier of the approval, ensures the CBRN SCBA meets existing NIOSH industrial 13F minimum SCBA performance requirements to Subpart H. The CBRN SCBA candidate is required to attain Part 84 approval prior to being submitted for NIOSH CBRN protection testing. Part 84 compliance review by NIOSH is conducted in the initial review of the new extension CBRN SCBA application

- Tier 2— The second tier is a compliance certification of the SCBA by an independent third party qualified testing organization to *NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*. *NFPA 1981* contains critical SCBA performance requirements unique to firefighting and operation in hazardous environments [NFPA 1981, edition 2002, effective August 8, 2002]. As the nationally recognized consensus standard for SCBA equipment used by the U.S. Fire Service, compliance with NFPA 1981 protocol ensures the CBRN SCBA can withstand routine structural fire hazard exposure while still maintaining minimum CBRN protection qualities. NFPA compliance testing for the program incorporates the enhanced performance requirements of the *NFPA 1981* standard including higher minimum flow rates and improved breathing resistance. *NFPA 1981* testing simulates SCBA use conditions through environmental exposures including high and low temperature conditions, heat and flame exposure, accelerated corrosion, particulate exposure, and vibration. Lens abrasion and communications (i.e., speech intelligibility while wearing the SCBA) are additionally evaluated. These critical systems tests show how the NIOSH CBRN SCBA approval is interwoven with existing standard setting organizations and utilizes the best of available technology to provide a higher level of combined protection.

- Tier 3— The third and final tier consists of three NIOSH Special Tests involving direct exposure of the candidate CBRN SCBA hardware to select chemical warfare agents/terrorism agents followed by human test subjects donning the adapted SCBA facepiece and maintaining an acceptable laboratory protection level against corn oil particulates. CBRN special tests for the program incorporate requirements resulting from an extensive effort to identify the hazards a first responder is likely to encounter at an emergency event and to define laboratory levels of respiratory protection against toxic select agents and a non-toxic protection level particulate required for the first responder. Live agent testing uses a pre-screening process on the SCBA by first exposing the respirator to TDA-99M non-toxic oil aerosol to check

for gross air pressure boundary leaks. If the SCBA passes the pre-screening TDA-99M process, the SCBA system is deemed qualified to be placed in the real live agent test box on the SMARTMAN headform. While on the real live agent exposure platform test box, another TDA-99M process is done to verify sealing and air pressure boundary properties are repeatable on the headform prior to agent exposure. The CWA sarin and sulfur mustard are then used to evaluate the CBRN SCBA protection of the breathing zone on a static manikin headform and the resistance of the SCBA systems and accessories to agent penetration and permeation. Once this test is complete, a NIOSH NPPTL Laboratory Respirator Protection Level (LRPL) test is conducted based on the number of specified sizes of facepieces designed by the respirator manufacturer. LRPL particle size exposure utilizes 11 specific tasks that each human subject must perform successfully while wearing and maintaining a seal to attain the level of performance needed to protect against highly toxic CBRN agents. LRPL evaluates the performance of the identical LAT facepiece only, not the entire SCBA. The facepiece is adapted by using a manufacturer specific negative pressure adapter and particulate filtration media. This adapted facepiece is then self donned by a specific number of human test subjects and evaluated for LRPL passing results. These special CBRN tests are implemented under the provisions of 42 CFR 84.63(c):

a) Live agent tests (LAT) measure CWA permeation and penetration resistance against sarin vapor (GB) and sulfur mustard (HD) liquid and aerosol. Actual agent, commonly known as "live agent", is used to gain maximum assessment of the respirator against the unique penetration properties of GB liquid aerosol and the caustic permeation properties of HD liquid aerosol and HD liquid droplets.

b) The laboratory respirator protection level (LRPL) test ensures that the facepiece seal and the interface between the user and the SCBA facepiece perform to an established NIOSH LRPL protection level on a panel of human test subjects. The human test subjects are assessed per a human subject review board (HSRB) protocol and are intended to approximate 95% of the facial sizes of a specific user population. Los Alamos National Laboratory (LANL) size distribution panels are used to categorize the facial size parameters determined from the human test subject pool.

A NIOSH administrative review of tested part numbers, showing passing results under Tier 3 is conducted during the final review of

the application. This is done against the part number listing showing compliance to NFPA 1981. If any part number changes, material changes or air-pressure boundary changes are made to allow the SCBA to pass CBRN testing, the passing configuration assembly matrix review compares the listing and generates misses or a clean review. The final assembly matrix is then reviewed by the NFPA testing agency for final NFPA compliance and NIOSH NPPTL and all part numbers must demonstrate NFPA compliance and NIOSH CBRN test compliance or be removed from the NIOSH CBRN SCBA assembly matrix prior to issuance of a NIOSH CBRN SCBA approval letter.

2) As in most explosions, fire hazards are normally present in various forms. If the CBRN agent is dispersed in an improvised explosive device or detonated munitions, fire hazard protection will be provided by the NIOSH CBRN approved SCBA. Firefighters and Explosive Ordnance Disposal (EOD) specialists are examples of end users that benefit from NFPA final compliance review of candidate NIOSH CBRN approved SCBA. The most current website tool available to responders, at the time of publication, is the Responder Knowledge Base (RKB) search engine provided by the National Memorial Institute for the Prevention of Terrorism (MIPT). The RKB link is http://www1.rkb.mipt.org/, 29Nov04.

a. Life Saving Features

The CBRN SCBA provides the wearer with respiratory protection in potential, known or unknown hazardous environments and may be used for entrance into and escape from atmospheres that are immediately dangerous to life and health ((IDLH). All NIOSH approved CBRN SCBAs listed on the website are NFPA and NIOSH CBRN compliant and may be used for fire fighting and/or CBRN incident response. Not all components and accessories offered by manufacturers are approved for use on the NIOSH CBRN SCBA. Users must check the NIOSH approval label inserted in the user instructions and be trained on how to interpret the assembly matrix and numerous part numbers that make up an approved SCBA configuration. All of the part numbers when fitted together in a specific design create design features and benefits that the specific manufacturer intends to provide to the end user. Examples of these design features are the heads-up display, redundant, dual and primary pressure gauges, PASS device, communications interfaces, cylinder construction variations and end of (remaining) service time indicators. These features on a NIOSH approved CBRN SCBA respirator provide the user with awareness of SCBA operation before, during and after use. Safety features to aid a distressed user include Rapid Intervention Crew (RIC) fittings, and bypass purge valves.

Heads-Up Display

The heads-up display, also known as HUD, is positioned inside or outside the SCBA facepiece, and is a visible display of at least cylinder pressure, system condition status and alert signals in the form of LED readouts or other signal devices. At minimum, the HUD will display the remaining quantity of breathing air, a measure of cylinder pressure, and alert the user when the remaining quantity of breathing air reaches 50%. Where batteries are used in HUD, alert to battery life remaining at 2 hours is also a feature. Wireless remote HUDs or HUDS with integral wiring are tested for strength and effectiveness. The HUD is a design requirement as well as a feature for NIOSH CBRN SCBA approved under NFPA 1981, 2002 edition. It is not present in NIOSH approved CBRN SCBA certified under the NFPA 1981, 1997 edition, or any editions prior 1997. Currently, NIOSH CBRN SCBA carry approvals for CBRN protection as NFPA 1981, 1997 edition or NFPA 1981, 2002 edition, depending on when the applications were submitted to NIOSH and the request of the applicant. Recognizing an SCBA with a HUD attached is a indicator that it is NFPA 1981, 2002 compliant.

Gas or Air Pressure Gauges

Pressure gauges indicate the quantity of breathing gas or air remaining in the cylinder and hardware. Pressure gauges are required to be redundant and to be visible to the wearer at any time. The primary air pressure gauge can be a mechanical gauge that operates with the pneumatic air pressure of the SCBA or as a visual signal continuously displayed as part of the facepiece heads-up display as discussed above.

EOSTI: End-of-Service-Time Indicator

End of (remaining) service time indicators (EOSTIs) are required to alert the user when the cylinder is low on air. EOSTIs could consist of either an audible alarm (whistle); a visually flashing light emitting diode (LED) light in the heads-up display of the facepiece; or a vibrating alarm. Depending on the edition of the NFPA 1981 requirement that was current during the year the CBRN SCBA was approved, some units could have more than one independently operating EOSTI, each of which will be recognized by different human senses. Activation of the alarm of each EOSTI shall be independent of any other EOSTI, per NFPA 1981, 2002.

RIC UAC or RIT Fitting

The rapid intervention crew/company universal air connection (RIC/UAC) male fitting is an air connector that transfers or replenishes breathing air to the SCBA breathing air cylinder. The RIC fitting is only a design requirement for CBRN SCBA approved under the NFPA 1981, 2002 edition. It is not present in NIOSH approved CBRN SCBA certified under the NFPA 1981, 1997 edition.

Bypass Valves for Use in the Event of Regulator Failure

High-pressure air from the cylinder passes through both a first and second stage regulator and is reduced to a variable volume of air that can be delivered to the facepiece at a rate determined by the physical demands of the user. NIOSH testing requires that the SCBA second stage regulator fail in the open position. In the event that a regulator fails in the "closed" position, air delivery will stop to the facepiece. The failed regulator can be "bypassed" by opening the red purge or bypass valve, purge-on, thus restoring rapid flow to the facepiece. The manufacturer's user instructions will specify how to use the bypass valve in the case of a regulator failure. True bypass values on belt mounted SCBA have not been submitted for CBRN approval.

b. SCBA System Rated Service Time

Rated service time is the length of time that an SCBA will continue to function at a specific use rate tested in accordance with 42 CFR Part 84. Traditionally, it is 30, 45 or 60 minutes in the United States and it is determined during NIOSH testing of the capacity of the air cylinder. One analogy that is commonly used is to identify the SCBA rated service time by calling out the time on the air cylinder. For example, select SCBA may be known as having a 30-minute bottle, a 45-minute bottle or a one hour/60-minute bottle. The rated service time of a CBRN SCBA is indicated on the SCBA backframe harness that carries an adhesive NIOSH approval label. That same service time is also explained in manufacturer's user instructions NIOSH paper label insert and on the NIOSH assembly matrix maintained by the federal government. A typical rated service time on an inserted label is listed under the protection column of the label and reads "SC/PD/CBRN 30 min/4500 psig". Different manufacturers may identify specific rated service times or pressure durations of SCBAs by unique names such as 4.5, 2.2, 3.0 or L-30 etc. NIOSH does not approve a 90-minute rated service time in non-CBRN or CBRN protected open circuit, pressure demand SCBA. The rated service time is approved per the manufacturer's application request and NIOSH testing of the SCBA for compliance to that requested service time. While time is understood in the type of cylinder attached to the SCBA, air pressure of the cylinder vessel is not always as easily correlated. For example, open-circuit, pressure demand, SCBA, with rated service times of 30-minutes, 45-minutes, or 60-minutes may have all one, two or three types of air pressure: 4500psig, 3000psig or 2216psig on one NIOSH approved paper insert label. 2216psig rated cylinders typically do not exist as 60minute rated service time SCBA. One type of air pressure can have all three types

of rated service times in the form of different sized cylinders. The approved rated service time of an SCBA is typically based on air consumption at a moderate work rate and under laboratory conditions. High work rates and differences in user lung capacity can significantly reduce or alter the actual service time achieved. CBRN SCBA rated service times adopt the industrial rated service time values based on the first tier of CBRN approval for SCBA. Actual service time is usually less than the rated service time indicated on the label due to the variables involving the physical condition of the user, the level of exertion and stress on the user, initial cylinder start pressure levels, ambient temperature, and other physical constant conditions. CBRN SCBA are not tested against live agents with the cylinder affixed. Only the appropriate neck cylinder valve at the proper torque foot pounds of pressure adapted to a pressurized air line is tested in the CBRN SCBA Live Agent Test/Special HD and GB tests.

c. Cylinder Compliance

Breathing gas or air cylinders used with SCBA hardware are pressurized vessels. The U.S. Department of Transportation (DOT) regulates the shipping, labeling, qualification and periodic re-qualification of these cylinders. Cylinders are tested and maintained as prescribed in 49 CFR Part 173 and Part 178, Shipping Container Specification Regulations, DOT. The respirator manufacturer can provide specific guidance on reading and interpreting the DOT markings on cylinders and how the hydrostatic test date markings are updated when a cylinder is re-qualified. OSHA requires that compressed breathing air for atmosphere supplying respirators, which is what the CBRN SCBA is, must meet the least requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7-1, 1989 [OSHA 1910.134 (i) (1) (ii)]. NFPA 1989, *Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection*, 2003 Edition, is also a reference. Interchangeable use of oxygen and breathing air is not permitted in the industrial approvals or the CBRN approvals for SCBA. Quick charge, also known as "rapid fill" from cascade air supply sources is done at the explicit discretion of the incident commander. Quick charge assemblies on CBRN SCBA are approved as part of the CBRN SCBA system but the interfaces required for safely matting connections to air sources are not CBRN approved by NIOSH. Users should ensure all safety measures are enforced and practiced if quick charge operations are used.

CBRN SCBA user should look for the proper shape or roll of the cylinder to ensure it conforms to what they know is correct, any unusual wear and tear indicators, discoloration from burns, cracks in the cylinder threads or cylinder neck valve housing or clogged holes in the burst disc. A full cylinder is then attached to the SCBA hardware and the SCBA is checked

for proper pressure reducing between regulators. Typically, hydro static test dates and other related cylinder topics are controlled by the issuing fire department qualified technicians; however individual department standard operation procedures may require end users to physically check the hydro test date for expiration and process the cylinder for re-qualification. New composite cylinders rely on epoxy resin label updates in the form of a three figure code that is the month number, a unique inspector mark and then immediately followed by a calendar year two digit number, for example: 7 ^ 05. Aluminum cylinders rely on metal digit imprints in neck cylinder area, similar to the three figure code.

d. Industrial Protection

"Industrial protection" for respirators refers to traditional industrial workplace respirators approved under NIOSH 42 CFR part 84. This certification ensures the CBRN SCBA meets existing industrial SCBA performance requirements consisting of maximum 35 lb weight, service life indicators, gas flow, service time, carbon dioxide, low temperature exposure, reliable use tests and human subject man tests. CBRN SCBA are compliant to all industrial standards and are traditional open circuit, positive pressure or pressure demand, apparatus and thus are devices in which the pressure inside the facepiece, in relation to the immediate environment, is accepted to maintain a slight positive pressure in the human subject breathing zone during both inhalation and exhalation cycles. While this positive pressure appears to be adequate for traditional industrial workplaces and firefighting, chemical warfare agents are not impeded by this positive pressure inhalation-exhalation cycle on regular industrial approved SCBA in confined space exposures conditions.

e. Why CBRN Protection?

Chemical, biological, radiological and nuclear agents and effects challenge respirator materials, air pressure boundaries and interfaces. CBRN SCBA design requirements and technology have made rapid advances over the past three years to ensure that any given approved design allows the SCBA to provide the minimum amount of quantifiable breathing zone chemical agent protection, specifically GB and HD, as determined under ideal laboratory conditions. If there is air pressure disequilibrium due to valve orientation, valve material porosity or material misaligned forging, GB will most likely penetrate and permeate the opening and attempt to create equilibrium. Dead spaces that allow GB to build up and actively penetrate or permeate can be flushed out by exhalation cycles. This process has been witnessed in certification as one of the effective methods in protecting air pressure boundaries against GB penetration or permeation. GB vapor or aerosol will penetrate or permeate silicone surfaces that are used as air valves or facepiece materials. The amount of concentration gradient penetration pass silicone is dependent on the level

of GB concentration and silicone material thickness. Of course, GB and HD hardened/resistant materials containing no silicone, blends of silicone and butyl or minimum amounts of silicone are the ideal protection designs.

Hard non-porous surfaces, like coated polycarbonate, will allow quick run off of liquid HD will most likely not allow the surface to be permeated unless the HD agent is allowed to collect in a lip or threaded area and allowed to permeate over time. This is one of the reasons why gross decontamination of known exposures in a timely fashion will mitigate the permeation effects of select CBRN agents. HD in liquid form will aggressively attack thin plastic membranes, silicone membranes, stress points where two like or different materials interface and other porous surfaces that are not resistant to the caustic effects of sulfur mustard blister agent causing pressurized points to violently expand, crack and physically crumble under slight external pressure or internal matting surface pressures. SCBA with NIOSH CBRN protection incorporate the performance requirements of reliable industrial protection, coupled with NFPA compliance fire protection, overarched by live agent GB and HD testing followed by corn oil protection level testing to produce a SCBA that offers the highest level of respiratory protection available to the US emergency responder.

The fact that CBRN protected SCBA exist is, in fact, a deterrent to the terrorist that may consider using CBRN agents as a state sponsored weapon or as a terrorist weapon. Without the benefit of a post 9/11 chemical terrorism incident to compare to, CBRN protected respirators, tested and approved in a laboratory environments, are currently designed to protect against intelligence templated threat CBRN agents in what has been commonly referred to as "anticipated most credible events" which are sometimes confused with what is known as "worst case (use) conditions".

U.S. anthrax attacks of autumn 2001 and other CBRN type events collated by the Monterey Institute of International Studies (MIIS), 2001, show various degrees of viable chemical and biological terrorism attempted and executed throughout the U.S. east coast and the international community. In the case of chemical agents, significant attacks initiated by the Japanese religious cult Aum Shinrikyo, now called Aleph, have occurred from April 1990 to April of 2000. CBRN agents of choice were, and most likely still are, VX, GB, variations of anthrax cultures and anthrax vaccine strains, variations of botulinum cultures, phosgene, hydrogen cyanide, sodium cyanide, sulfuric acid mixtures and hydrogen fluoride. Radiological agents in the form of dirty bombs were not identified by MIIS during the 2001 assessment. However, MIIS did identify radiological incidents that were planned and foiled.

These Aum Shinrikyo "rad-attacks" consisted of confiscation of plans related to cyber attacks on Japanese nuclear reactors and conventional attacks on Japanese nuclear processing plants. Additionally, Aleph/Aum Shinrikyo copy cat incidents documented by MIIS involve tear gas, chloropicrin, sarin hoaxes, and chlorine like, white colored liquids.

Any terrorist researching the plausible uses, effects and medical impacts of common industrial materials, chemical warfare agents, biological pathogens and toxins, radiological isotopes or irritant compounds can easily access select information about what common CBRN product developers are doing and ways to defy that research. See the link http://www.janes.com/defence/news/jdw/jdw041108_1_n.shtml 23Nov04.

Local US media continually report that U.S seaboard ports, inland ports, large inland terminals and possibly schools/universities/sporting events may have a higher risk of being a terrorist target. What is not stressed, and understandable so, is the fact that the successful use of jet airplanes has been done once and may be seen as an ideal strategic tactic for re-use by the terrorist despite enhanced federal security measures. See the link http://www.usatoday.com/travel/news/2004-11-21-plane-diverted_x.htm CBRN agent physical constants make them ideal inhalation threats and the respiratory system is considered, by most analysts, as the primary route of entry for CBRN agents, followed by dermal exposure. Irritants such as tear gas/CS, mace, pepper spray or some other irritant were sprayed in the first class cabin of American Airlines Flight 11 to force passengers and flight crew toward the rear of the aircraft. [9/11 Commission Report, page 5, 2004]. Unprotected personnel have historically been the targets of chemical warfare agents or irritants. The use of an irritant in the hijacking of American 11 shows the aptitude of the terrorist to understand the immediate effects of irritant particulate agents and the psychological outcomes of using an irritant onboard a commercial airliner.

The terrorists used several of the commonly understood military combat tenets consisting of surprise, audacity, shock and speed to accomplish their 9/11 terrorist missions. Couple those tenets with the use of a non-persistent irritant chemical compound, bomb threats and a warrior suicide mentality, the success of the September 11, 2001 attacks is apparent. Integrating CBRN agents into a focused pre-planned terrorist attack is not expected to be easy for the terrorist, however, if the 9/11 attacks are indicators of terrorist planning capability and mission execution, the potential use of CBRN agents in future terrorism incidents cannot be discounted. See the link http://edition.cnn.com/SPECIALS/2002/terror.tapes/ 23Nov04.

If CBRN agents are the terrorism tool of primary or secondary choice in the next attack, CBRN protection, afforded by NIOSH CBRN SCBA, is

the highest level of respiratory protection available. And when properly maintained, used and stored, it is expected to provide the level of protection for the life of the SCBA, endorsed by the manufacturer, the NFPA and the NIOSH.

Chemical Agents

Airborne Industrial Chemicals, Toxic Industrial Chemicals or Toxic Industrial Materials (TIC/TIM):

TIC and TIM are chemical elements or compounds used in industrial applications existing in the physical states of gases, vapors, liquids, solids or solid and liquid particulate aerosols.

Examples are Chlorine, Anhydrous Ammonia, Phosphine, Ethylene Glycol Dinitrate, 1,1- Dimethylhydrazine, Acetylene, Butane, Cyclopropane, Ethylene, Methane, Propane, Gasoline, and Hydrogen.

Specific Chemical Warfare Agents (CWAs), Nerve and Blister Agents:

Nerve agents: GB (Sarin), GA (Tabun), GD (Soman), GF (cyclohexyl Sarin), and VX. Nerve agents consist of a group of very toxic organophosphate chemicals specifically designed for military warfare. Most of the nerve agents exist as liquids, but some, such as GB, volatilize into the air on their own. GB in a liquid state has the consistency of water and its name is derived from the four German pioneers Schrader, Ambros, Rudriger and van der L 'IN'de. VX, a persistent nerve agent similar to motor oil, is the least likely to become airborne, but in conditions involving explosions, it could vaporize and spread in the air. Nerve agents disrupt how nerves communicate and control muscles, glands, and organs in the human body. Dusty CBRN agents or next generation CBRN agents are not within the scope of this document.

Additional information on nerve agents can be found at the following website: NIOSH emergency response cards
http://www.bt.cdc.gov/agent

Blister agents: HD (sulfur mustard), nitrogen mustard (HN-1, HN-2 and HN-3) and Lewisite (L, L-1, L-2 and L-3). Blister agents or vesicants are chemicals, which have severely irritating properties that produce fluid filled pockets on the skin and cause damage to the eyes, lungs and other mucous membranes. HD is a liquid at ambient temperatures, but can vaporize on its own or be dispersed as a vapor in an explosion. HD in the liquid state permeates surfaces at the molecular level and can cause select materials to become brittle, break or expand rapidly.

Additional information on sulfur mustard can be found at the following website:
NIOSH emergency response card for HD (sulfur mustard)
http://www.bt.cdc.gov/agent/sulfurmustard/erc505-60-2pr.asp

Biological Agents

Biological agents are particles and they will not penetrate the materials of properly assembled and fitted respirators or protective clothing. Some terrorism or state sponsored devices may have the capacity to disseminate large quantities of biological agents or materials as aerosols. Biological agents could be dispersed in the form of liquid droplets, liquid aerosols, or solid aerosols (a powder of bacterial spores, for example).

The CBRN SCBA provides protection against airborne biological terrorists' threats including Anthrax, Brucellosis, Glanders, Pneumonic Plague, Tularemia, Q Fever, Smallpox, Venezuelan Equine Encephalitis, Viral Hemorrhagic Fevers, T-2 Mycotoxins, Botulism, Ricin, and Staphylococcus Enterotoxin B. NIOSH respirator policies state that under specific conditions, SCBA reduces the user's exposure to industrial hazards by a factor of at least 10,000. This reduction is true whether the hazard is from airborne industrial particles, an industrial chemical vapor or an industrial gas. Respirators providing lower levels of protection are generally allowed once conditions are understood, defined and exposures are determined to be at considerably lower levels.

Additional information on bioterrorism agents can be found at the following website:

http://www.bt.cdc.gov/agent/agentlist.asp

Radiological and Nuclear Agents

Airborne particulate matter (liquid and solid aerosols) has the ability to carry radioactive particles with it (i.e., alpha and beta particles released from the atomic nuclei of an unstable isotope cling to dirt particulate). The CBRN SCBA provides protection from breathing this particulate-borne radiation by stopping all particles suspended in air.

Protection is not provided against high energy gamma radiation, which consists of the emission of photons from the atomic nuclei of a substance undergoing radioactive decay. Protecting responders from high energy gamma radiation requires minimizing exposure time and maintaining appropriate distance from the source based on the measured radiation exposure values at the site.

Protection is not provided against the explosive energy effects of a conventional or nuclear detonation creating energy blast waves and the resulting high velocity debris, which will likely impact the respirator.

Radiological refers to particulate-borne radiation dispersed by detonation of a radiological dispersive device (RDD) or a radiological improvised explosive device (R-IED), also known as a "dirty bomb", which is a conventional explosive device that has been surrounded by or contaminated with some form of radioactive isotope material.

Nuclear refers to particulate-borne radiation dispersed by detonation of an improvised nuclear device (IND). An IND is intended to cause a yield-producing nuclear explosion. An IND could consist of diverted nuclear weapon components or a modified nuclear weapon. Unlike an RDD that can be made with almost any radioactive material, IND requires fissionable material—highly enriched uranium or plutonium—to produce nuclear yield.

Additional information on radiological and nuclear agents can be found at the following website:
http://www.bt.cdc.gov/radiation/index.asp

f. Other Hazardous Atmospheres

Unknown Atmospheres

The NIOSH approved CBRN SCBA are expected to provide protection against unknown toxic compounds and oxygen deficiency in unknown atmospheres. Air purifying respirators of any type are not recommended in lieu of SCBA or Supplied Air Respirators. Go to the following link http://www.cdc.gov/niosh/npptl/topics/respirators/cbrnapproved/apr/default.html to understand why a CBRN SCBA is recommended over a CBRN APR for use in unknown atmospheres or atmospheres that are expected to be high in toxic compounds. Unknown atmospheres are expected to be those atmospheres where the contaminant type and concentration is not known by the user prior to entry. The CBRN SCBA may be used for emergency or planned entry into unknown atmospheres provided the scene is secure and proper two-man entry rules are in effect per OSHA or local incident command authority. Additionally, current CBRN SCBA are not required to be intrinsically safe and therefore, lower explosive limits (LEL) must be determined safe before entry or all potential spark emitting sources on the SCBA must be disabled.

Immediately Dangerous to Life or Health (IDLH) Atmospheres

NIOSH approved CBRN SCBA provide protection against atmospheres at or close to levels considered immediately dangerous to life or health

(IDLH). Under the *NIOSH Respirator Selection Logic, October 2004 and NIOSH Interim Recommendations for Firefighters and Other First Responders for the Selection and Use of Protective Clothing and Respirators Against Biological Agents*, documents, one of the most protective respirators are self-contained breathing apparatus equipped with a full facepiece and operated in a pressure-demand mode. CBRN SCBA is a full face, pressure demand respirator and recommended for use in an IDLH atmosphere. This type of respirator is also selected for firefighting, entry into oxygen-deficient atmospheres, emergency situations, and entry into an atmosphere that contains a substance at a concentration greater than 2,000 times the NIOSH Recommended Exposure Limit (REL) or OSHA Permissible Exposure Limit (PEL) [NIOSH Pocket Guide, 2004] for a compound.

The current NIOSH definition for an IDLH exposure condition is stipulated in the *NIOSH Respirator Selection Logic* [NIOSH Publication No. 2005-100]. Additionally, it can be found in the *NIOSH Pocket Guide to Chemical Hazards* http://www.cdc.gov/niosh/npg/npg.html *23Nov04.*

In these documents, IDLH is defined as "an exposure condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. The purpose of establishing an IDLH exposure level is to ensure that the worker can **escape** from a given contaminated environment in the event of failure of the respiratory protection equipment. The IDLH is considered a maximum level above which only a highly reliable breathing apparatus providing maximum worker protection is permitted. Any appropriate approved respirator may be used to its maximum use concentration (MUC) up to the (known) IDLH concentration." The original definition of IDLH was derived from 30 CFR 11.3(t) and the concept of incorporating a safety margin using Standard Completion Program IDLH values were based on the effects that might occur as a consequence of a 30-minute exposure. However, the 30-minute exposure was NOT meant to imply that workers should stay in the work environment any longer than necessary; in fact, every effort should be made to exit immediately.

Oxygen-Deficient Atmosphere

An oxygen-deficient atmosphere is defined by NIOSH as an atmosphere with an oxygen concentration below 19.5% at sea level. The minimum requirement of 19.5% oxygen at sea level provides an adequate amount of oxygen for most work assignments and includes a safety factor. The safety factor is needed because oxygen-deficient atmospheres offer little warning of the danger, and the continuous measurement of an oxygen-deficient atmosphere is difficult. Oxygen concentrations below 16% at sea level produces decreased mental effectiveness, visual acuity, and muscular

coordination, and at below 6% oxygen, death will result. Often only minor subjective changes are noted by individuals exposed to low concentrations of oxygen, and collapse can occur without warning. Since oxygen-deficient atmospheres are life-threatening, only the most reliable respirators are recommended; the most reliable respirators are the self-contained breathing apparatus or the supplied-air respirators with auxiliary self-contained escape bottles for industrial operations and the CBRN SCBA for CBRN incident operations. See the respirator selection logic link at http://www.cdc.gov/niosh/docs/2005-100/default.html for further information.

NIOSH recommends a supplied air breathing system to achieve adequate levels of oxygen for work in oxygen-deficient atmospheres. The NIOSH approved CBRN SCBA carries an independent supply of compressed gaseous breathing air that is not connected to a stationary breathing air source. A compressed gaseous breathing air supply is required in 42 CFR 84 to meet the applicable minimum grade requirements for gaseous air set forth in the Compressed Gas Association *Commodity Specification for Air, G-7-1*, 1989 publication. Compressed oxygen cannot be used in a device designed for compressed breathing air (an SCBA cylinder) and is never recommended by NIOSH. In fact, 42 CFR 84 prohibits certification of any device designed to permit interchangeable use of oxygen and air. It is an general practice safety rule that elemental oxygen can never be used in a device unless it is specifically designed for that purpose.

g. SCBA Systems Checks

The manufacturer's user instructions (UI) gives detailed procedures for performing checks of CBRN SCBA required components and accessories. Checks include an inspection of the material integrity for signs of wear or damage and an operational check of the function of the components and accessories. The manufacturer will specify in the UI what checks are necessary based on the components and accessories particular to that CBRN SCBA model.

Among the checks which should be performed before use are:

- Inspection of facepiece components and accessories
- Inspection of backframe and harness assembly
- Check of cylinder valve assembly function
- Check of cylinder gauge function and that cylinder is fully pressurized
- Regulator function (both first stage and second stage regulators)
- Bypass valve function
- Function of all end-of-service-time-indicators (EOSTI)

- Function of heads-up-display (HUD). Note: HUD is only a design requirement for NIOSH CBRN SCBA approved under *NFPA 1981, 2002 edition.*.
- Check of integrity of hoses for cuts, abrasions, cracks, heat and chemical damage, and that the hose connects are tight
- Check that the hydrostatic test date of the cylinder is current
- Check function of personal alert safety systems (PASS) (if present)
- User Seal Check of facepiece and leak test of facepiece.

h. Facepiece Fit Testing

A respirator will not provide its intended level of protection unless it fits the user properly. Leak testing the SCBA is one of the first actions a fire department does upon receipt of new SCBA. NIOSH respirator selection logic defines a fit factor as a quantitative measure of the fit of a specific respirator facepiece to a particular individual. A fit-test is further defined as the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual (See also Qualitative Fit Test (QLFT) and Quantitative Fit Test (QNFT)).In the course of conducting a fit test a defined and proven method is used to select a respirator size that provides a protective fit. Determination of facepiece fit is to be done by either a qualitative or quantitative OSHA-accepted protocol specified in Appendix A of the OSHA Respiratory Protection Standard [29 CFR 1910.134]. The respirator program administrator is responsible for providing fit-tests to respirator users prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter to ensure continued, proper fit [29 CFR 1910.134(f)(2)]. Users should also undergo fit testing when changes in their physical condition could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight [29 CFR 1910.134(f)(3)]. The OSHA Respiratory Protection Standard [29 CFR 1910.134] mandates that facepieces, even for positive pressure units, be fit tested in the negative pressure mode. The user should have the option to try on different sizes of SCBA facepieces (small, medium, & large, for example) converted to negative pressure configurations. In addition to the industrial fit testing for traditional NIOSH 42 CFR 84 certification, human test subjects used in CBRN SCBA laboratory respirator protection level (LRPL) are quantitatively fit tested using TSI PORTACOUNT machines to confirm the hard to fit sized test subjects and then those same test subjects participate in the required corn oil chamber test trials during the NIOSH CBRN SCBA LRPL testing phase. User seal checks are done by the CBRN SCBA test subject without assistance from a second person or expert fitter. User seal checks are taught and trained in accordance with the most current manufacturer's user instructions. Facial hair, scalp hair lines, hair buns or unshaven faces can contribute to inadequate fit testing

results. Unshaven faces, hair lines that extend into the face-blank sealing area or hair buns that preclude the head harness from lying correctly contribute to poor sealing characteristics and are not recommended.

i Facepiece Seal Leak Checks, a User Seal Checks or Facemask Fit Check.

A user seal check is a method for determining whether a previously fit tested respirator has been properly donned (put-on) and properly adjusted to ensure an adequate facepiece- to- face seal or fit. NIOSH respirator selection logic defines a User Seal Check as "An action conducted by the respirator user to determine if the respirator is properly seated to the face." Respirator users should perform a user seal check every time the respirator is donned and before entering a contaminated area. A user seal check evaluates the seal of the respirator to the user's face by having the user put the facepiece under positive or negative pressure and noticing leakage. Effectiveness of the user seal check is dependent on the end user or assistant detecting any audible or visual changes in the respirator indicative of a air pressure boundary leak. User seal check procedures are located in Appendix B-1 of the OSHA Respiratory Protection Standard [29 CFR 1910.134]. Manufacturer's user seal check procedures, which are located in the manufacturer's user instructions specific to the model of respirator, are normally compliant with this OSHA reference. Specific respirator manufacturer user instructions may advise the wearer to conduct a 'facemask fit check' [Sabre SCBA User Instructions, March 2003]. This is the same as a user seal check. The facemask fit check is a unique process to the worn respirator, whereby the SCBA is fully donned, the cylinder valve is on, system charged and the wearer inserts two fingers into the mask face blank area to break the seal and check to determine if there is an outward flow of air (positive pressure). Once a sense of outward air is determined, under ideal conditions and no CBRN contamination present, the fingers are removed and the faceblank is allowed to re-seal to the face. At this point wearers may be advised to stop breathing for a few seconds and check that there is no sound or air flowing from the second stage regulator. This method for checking the fit is more of an on site seal check and is not recommended for use in a toxic environment.

i. Accessories

An accessory is an item provided with a respirator that does not affect its ability to meet the NIOSH certification requirements of 42 CFR Part 84 [NIOSH SAP January 2001a]. CBRN approved accessories are listed as components of a respirator on the NIOSH approval label. However, in the case of CBRN protection approvals, in order for any submitted accessories for a CBRN SCBA application to attain NIOSH CBRN approval, all accessories must be attached and serviceable during special CBRN special tests (LAT and LRPL). Personal alert safety system (PASS) device

batteries are not inserted in the PASS devices because operation of the PASS does not expose SCBA air pressure boundaries to ambient air. CBRN SCBA accessories may include electronic voice amplifiers, affixed hardwire communications devices, spectacle (eyeglasses) kits, integrated personal alert safety systems (PASS), stand alone PASS devices, fire service rescue belts and facepiece foam seal inserts.

j. Upgrade of Field Deployed Units to CBRN Protection Approval

In 2002, NIOSH implemented a program to approve CBRN retrofit kits for SCBA used by fire fighters and other first responders to terrorist attacks involving CBRN hazards. See the link http://www.cdc.gov/niosh/npptl/resources/pressrel/letters/lttr-031103c.html 23Nov04. SCBA units that were placed in service prior to issuance of CBRN approval may be upgraded to CBRN approval status through this program. Respirator users can contact the manufacturer of their current SCBA to see if a NIOSH Approved CBRN SCBA retrofit kit is available. Chapter 4, Section G. provides a detailed description of the requirements for approval upgrade of field deployed SCBA to CBRN protection.

Figure 2, Field deployed SCBA, minus cylinder, with CBRN SCBA upgrade kit attached and submitted for the NIOSH's NPPTL initial review. Notice the red vibra-alert label denoting it is a CBRN rated model as well as the harness assembly labels of showing NIOSH approval.

Chapter 3. Certification Approval Factors

a. NIOSH Assembly Matrix

NIOSH CBRN SCBA part number configuration management is done by specific software that records, deconflicts and compares numerous data

files on a SCBA and generates a master part number and equipment description matrix maintained by the NIOSH's NPPTL. This assembly matrix is normally an electronic file that shows a table of major subassemblies and accessories assigned to a particular respirator. The assembly matrix is the technical parts data for the NIOSH approval paper label insert located with the manufacturer's CBRN SCBA user instructions. The January 2001a version of the NIOSH standard application procedures for the certification of respirators defines an assembly matrix as a table of major sub-assemblies and accessories and should closely follow the format of the example shown in this manual in section C. A typical CBRN SCBA assembly matrix may list both industrial SCBA part numbers and CBRN part numbers or be a distinct and separate CBRN SCBA assembly matrix that simply tracks CBRN SCBA configurations only.

b. NIOSH Approval Label

Only respirators affixed with an adhesive CDC NIOSH CBRN Agent Approved label as shown below are certified by NIOSH for use in CBRN environments. To determine if a respirator is CBRN approved:

- Look to see if the CBRN agent approved label is on the respirator (See Figure 3.). If a respirator is CBRN-approved by NIOSH, it will carry this white with black lettering adhesive label. The label is required to be located on the backframe of the SCBA in a highly visible location. If this CBRN agent approved label is **not** on the SCBA, the device is **not** approved by NIOSH for use in CBRN environments. **Check the CBRN agent approved label to avoid use errors! If the label is worn off or unreadable, contact the manufacturer for a replacement label prior to entering a CBRN incident response. Ensure that you read the user instructions for all required component part numbers, accessory part numbers and specific additional NIOSH cautions and limitations prior to use.**

Figure 3. SCBA CBRN Agent Approved Adhesive Label.

- Additional information is provided through the NIOSH, matrix-style approval paper labels found in the instruction manual for the respirator. The instruction manual is shipped by the manufacturer with the respirator. The instruction manual, or operating manual or as it is also known, user instructions (UI), outline the general safety information, warnings, cautions, limitations and special cautions and limitations for the CBRN SCBA as defined by the manufacturer. These UI clearly state that use of the CBRN SCBA UI are intended for use by personnel who have successfully completed an approved manufacturer user training program. While UI routinely refer to CBRN SCBA as simply self contained breathing apparatus, SCBA are in fact, respirators and not just self-contained breathing apparatus or breathing apparatus (BA) as some fire department emergency responders understand [Michael Kreuger, 2004].

- The approval number or TC number for a SCBA respirator approved for CBRN protection includes a **CBRN** suffix (TC-13F-XXXXCBRN). If the approval number does **not** include a CBRN suffix, it is **not** certified by NIOSH for use by emergency responders in CBRN environments.

- The complete CBRN assembly must be composed of **only** those component parts listed in the row with the CBRN approval number on the paper insert label located in the UI. Each SCBA manufacturer has a unique part number for this paper insert label and it is normally located in the lower right corner of the label. Part numbers that are found **only** in the rows of the **non-CBRN** approvals **must not** be used as part of a CBRN SCBA assembly. Select manufacturers do not mix NON-CBRN part numbers with CBRN part numbers on the same label matrix. If the non-cbrn part numbers and the cbrn part numbers are inadvertently mixed and attached to SCBA hardware, the use of incorrect parts may cause death or injury and voids the NIOSH original approval for that TC number. See Appendix C for an example of a paper insert NIOSH CBRN label matrix.

Figure 4. Actual Back Frame Assembly with CDC and NIOSH CBRN Agent Approved Label, NIOSH Abbreviated Harness Sticker Label and SEI Compliance Sticker Label Shown. All three labels are required for CBRN compliance.

c. NIOSH CBRN SCBA User Instructions (UI)

User instructions specific to each CBRN SCBA are developed by the manufacturer for each unique model, reviewed by NIOSH for clarity and part of the final approval assembly matrix but not listed on the insert paper label found in the actual user instructions. These manufacturer's users instructions describe procedures such as, but not limited to, donning, fit, unit assembly, pre-checks for leakage, breathing air cylinder inspection and exchange, doffing, maintenance, cleaning, storage, and preparation for disposal. In all cases, the manufacturer's user instructions should be followed in accordance with local OSHA requirements and lead federal agency jurisdiction protocol.

d. NIOSH CBRN Cautions and Limitations [2] & [3]

NIOSH cautions and limitations are listed on the NIOSH CBRN SCBA respirator approval label contained in the manufacturer's user instructions. As stated, an example NIOSH CBRN SCBA approval label is shown in Appendix C. Specific manufacturer's cautions and limitations may also apply. **In all cases, all cautions and limitations must be strictly followed. Cautions and limitations I, J, M, N, O and S apply when non-CBRN conditions of use are present. Cautions and limitations Q, R, T and U are additionally applied to I, J, M, N, O and S when CBRN conditions are expected, known or being decontaminated.**

e. NIOSH Approval Life

The life of a NIOSH CBRN SCBA approval does not expire unless the production of the CBRN SCBA is suspended and the manufacturer notifies NIOSH that the product is no longer in production. NIOSH then does a controlled quality assurance action and physically deletes all relevant part numbers identified by the manufacturer as obsolete from NIOSH records. The approval number for the obsolete system still remains in the NIOSH system but the obsolete parts are no longer part of approved assembly matrices used for formal approval letters.

f. NFPA 1981 Edition at Time of Approval

CBRN SCBA must meet a compliance evaluation of the current edition of NFPA 1981 for *Open Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, Edition 2002* both before and after special CBRN tests. The *NFPA 1981* standard contains critical SCBA performance requirements unique to firefighting and operation in hazardous environments. *NFPA 1981* is the nationally recognized consensus standard for SCBA equipment used by the U.S. Fire Service. The enhanced performance requirements of the *NFPA 1981* standard including higher minimum flow rates and improved breathing resistance. *NFPA 1981* testing simulates SCBA use conditions through environmental exposures including high and low temperature conditions, heat and flame exposure, accelerated corrosion, particulate exposure, and vibration. Lens abrasion and communications (i.e., speech intelligibility while wearing the SCBA) are additionally evaluated. CO2 levels are also evaluated by NFPA 1981, 2002 edition, and the use of nose cups in SCBA is an end result of showing compliance to the 2002 edition.

g. CBRN SCBA Retrofit/Upgrade Kits

On March 11, 2003, NIOSH immediately began accepting extension approval applications for the evaluation of components and procedures to upgrade previously deployed (field-deployed) NIOSH-approved self-contained breathing apparatus to CBRN-approved configurations. The purpose of the program is to test and evaluate retrofit kits used to upgrade field-deployed SCBA, assure upgraded SCBA comply with approved CBRN SCBA configurations and assure quality of the components and procedures used to upgrade previous versions of the SCBA establish the CBRN-approved configuration. At the time of publication, two of six approved CBRN SCBA manufacturers have CBRN SCBA upgrade kit approvals for over eight different models of CBRN SCBA.

In addition to the NIOSH CBRN Agent Approved label, CBRN SCBA retrofit upgraded kits contain the replacement components, parts, materials, and operating instructions required to upgrade an existing SCBA configuration to the approved CBRN configuration. The

manufacturer's instruction manuals will provide a list of these components, and the retrofit application will contain the following:

1) The minimum technician qualifications for performing the retrofit, and the level of manufacturer training required,
2) A list of SCBA models certified for use with the CBRN approved retrofit kit,
3) Identification of the requirements for inspections and operational tests of the SCBA prior to performing the retrofit that are required to verify the SCBA complies with manufacturer quality and performance specifications for SCBA eligible to be retrofitted, (NFPA 1852)
4) Detailed procedures for replacing components, parts, and materials required to establish the CBRN SCBA configuration,
5) Guidance concerning the CBRN SCBA operating instructions and differences from normal SCBA operating instructions,
6) Post retrofit inspections and tests required to verify that the work has been performed properly and that the CBRN SCBA operates in accordance with NIOSH, NFPA, and manufacturer requirements. As a minimum, the post retrofit inspection and test must verify leak tightness of assembly and components, positive pressure (static face piece pressure), exhalation resistance, bypass function, remaining service life alarm operation, pressure gauge accuracy, and flow performance, and
7) Directions for installation of the NIOSH CBRN SCBA Retrofit Approval label.

CBRN SCBA agent approved retrofit kits will contain a NIOSH CBRN agent approved (retrofit) label that must be affixed to the respirator after the upgrade is completed and the unit has passed the required post retrofit inspections and tests. Only if an SCBA retrofit kit is CBRN approved by NIOSH, will it be identified with a "NIOSH CBRN Agent Approved Retrofit" label. If the NIOSH CBRN Agent Approved Retrofit label is not present, the retrofit kit is not approved by NIOSH for use by emergency responders in CBRN environments. **Check the NIOSH CBRN agent approved retrofit label to alleviate use errors!**

Figure 5. NIOSH SCBA CBRN agent approved RETROFIT Adhesive Label.

Figure 6. Cylinder neck valve assemblies, minus cylinders, in preparation for CBRN SCBA (NFPA 1981, 2002) upgrade kit application processing. Battery is for PASS device.

Chapter 4. Production Model Safety

a. Unique CBRN Markings

CBRN SCBA may have unique markings for individual production models which are voluntarily designated by the manufacturer. These unique markings, if present, are not required for NIOSH CBRN SCBA approval, but rather are present for the benefit of the user to ensure that CBRN tested components are installed in their CBRN SCBA. Among the forms these markings may take are color-coded stick labels with the printed letters *CBRN*, or components may be embossed with the letters *CBRN*. Placement of these markings can be found on facepieces , color-coded adhesive labels or distinct lettering placed on regulators.

b. Unique Administrative Labels

CBRN SCBA have unique administrative labels provided by the manufacturer on the SCBA or in various forms of literature that

accompany the SCBA. These unique labels provide written warnings, cautions, and informational statements on such topics, including, but not limited to:

- Indications of damage which would require a cylinder to be removed from service.
- Training requirements for use.
- Inspection.
- Maintenance.
- Cylinder storage pressure, if the SCBA is out of service.
- Recharging (filling) instructions.
- Approved state of use only when compressed air reservoir is fully charged with air meeting the requirements of the Compressed Gas Association specification G-7.1 for Type 1, Grade D air, or equivalent specifications.
- Use of adequate skin protection when worn in gases or vapors that poison by skin absorption for industrial use and all appropriate CBRN cautions and limitation statements and warnings.
- In making renewals and repairs, parts identical with those furnished by the manufacturer under the pertinent approval shall be maintained.
- Cautions to open valve slowly and to close valve after each use and when "out of air". Cylinders should never be allowed to be truly empty [Kreuger, Michael: November 2004].

c. Cautions and Limitations [2]

NIOSH cautions and limitations are listed on the NIOSH CBRN SCBA respirator approval label contained in the manufacturer's user instructions. An example of a NIOSH CBRN SCBA approval label is shown in Appendix C. The following NIOSH industrial cautions and limitations appear in Section 2 of that paper insert approval label and are identified with a superscript [2] on the paper label.

I - Contains electrical parts, which have not been evaluated as an ignition source in flammable or explosive atmospheres by MSHA/NIOSH.
(Note: Caution and Limitation 'I' will not be present on units which have met these evaluation requirements by MSHA/NIOSH.)

J - Failure to properly use and maintain this product could result in injury or death.

M - All approved respirators shall be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.

N - Never substitute, modify, add, or omit parts. Use only exact replacement parts in the configuration as specified by the manufacturer.

O - Refer to user's instructions, and/or maintenance manuals for information on use and maintenance of these respirators.

S - Special or critical user's instructions and/or specific limitations apply. Refer to user's instructions before donning.

(Note: Caution and Limitation 'S' will only be on the NIOSH approval label if specified by the manufacturer in the user instructions. When 'S' appears on the NIOSH approval label, the corresponding Cautions and Limitations, that apply under 'S', will be explained in a designated section of the manufacturer's User Instructions (UI).

d. Cautions and Limitations [3]

The following NIOSH cautions and limitations appear in Section 3 of the NIOSH approval label and apply specifically to use in CBRN environments. Cautions and limitations T and U deal with the limitations of use life in confirmed chemical warfare agent environments and are further explained in Chapter 6 of this document.

Q - Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazards.

R - Some CBRN agents may not present immediate effects from exposure, but can result in delayed impairment, illness, or death.

T - Direct contact with CBRN agents require proper handling of the SCBA after each use and between multiple entries during the same use. Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, dispose of the SCBA after decontamination.

U - The respirator should not be used beyond 6 hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation.

e. Manufacturer's Warning and Caution Statements

The manufacturer's UI for each production model may specify unique warning and caution statements specific to each model and its unique manufactured design. Examples are hatch air way second stage regulators or manual slide or push-in second stage regulators. The respirator training program should include instruction on understanding and training concerning these manufacturer specific warning and caution statements.

f. Safety Default to Manufacturer's User Instructions

The manufacturer's UI are specific for each CBRN SCBA production model. Users should rely on the OSHA regulations with NIOSH recommendations and the manufacturer's UI as the best source of safety and use information for their CBRN SCBA. Users should also contact the manufacturer with specific questions if their concerns are not addressed in the UI or situations involving use are not addressed by the UI in training or real world response.

g. Indicators of Chemical Agent Penetration

Specific chemical warfare agents, particularly HD, have the ability to cause catastrophic material failure of components and accessories which could cause injury or death to the user. Many CBRN SCBA components and accessories incorporate state-of-the-art hardened polymer material to protect against the aggressive nature of chemical warfare agents, and CBRN SCBA have met laboratory test criteria against the chemical warfare agents GB and HD to measure penetration and permeation resistance of a fully operating CBRN SCBA system. However, it remains important for users to be aware of indicators of material failure of components and accessories in the unexpected event catastrophic material failure does occur unknowingly or knowingly. Laboratory testing has demonstrated that in industrial rated SCBA, GB seeks out crevices and dead space cavities and penetrates non-hardened surface interfaces or air pressure boundary materials such as silicone. HD has shown to be an aggressive permeating compound and attack specific plastic components of any exposed surface of the SCBA and particularly those exposed components on facepieces that are under mechanical stress due to tension or internal valve or spring pressure. Liquid HD if allowed to stay on a flat surface can create grazing of the surface and contribute to seal compromises. HD can cause brittleness and cracking to untreated polypropylene facepiece material or harness material. User should inspect their CBRN SCBA when in a safe location and use safe handling procedures during use for any signs of material cracking, tearing, and component separation which could be caused from chemical warfare agent exposure. The two man buddy system is also recommended to observe visible indicators of CBRN agent effects on exposed surfaces of CBRN SCBA.

h. Use Life

A unique "use life" limitation of a continuous 6.0 hour period beginning at the initial time of a confirmed exposure to chemical warfare agents of the G-, V- H- and L series applies to the NIOSH CBRN SCBA. Specific guidance on use life is addressed in Chapter 6. Some variations on this

rule are possible and are discussed in this document. Confirmed CWA contamination presence is the key to determining the 6 hour start point of contamination on a CBRN SCBA. Therefore, instruments designed to detect, at stated concentration levels, are required to be on the terrorism site. Once detection confirms the agent type and quantity present, the CBRN SCBA use life of 6 hours starts. The 6 hour use life rule means **6 continuous hours** in a single shift, day, or event. It does not mean 6 individual one-hour exposures in one shift or one day, nor does it mean six different one hour exposures over the course of six different days.

CHAPTER 5: 'Service Life', 'Rated Service Time' and 'Use Life' Terminology

Three distinct time limitations relating to the actual use of a CBRN SCBA are '**Service Life', 'Rated Service Time',** and **'Use Life'**.

a. **'Service Life'** of CBRN SCBA and Components

Refers to the length of time the system as a whole or individual components (for example, facepiece, harness assembly, or regulators) are expected to remain functional based on time, exposure event, or number of uses. If the SCBA is exposed to vapor or liquid chemical warfare agents, the restriction of use life applies. The SCBA manufacturer may specify service life information for the system as a whole or for particular components in the manufacturer's UI. When this information is available from the manufacturer, it should be followed. To ensure all components are functional and free from damage and excess wear, an inspection of all SCBA components should be performed prior to the beginning of each use. In making renewals and repairs, parts identical with those furnished by the manufacturer under the pertinent approval shall be maintained.

- Service Life of Air Cylinder

The service life of an air cylinder is the length of time the cylinder can remain functional before it must be removed from service and permanently retired. All manufacturers' guidance on cylinder service life is provided in the manufacturer's UI or available from the cylinder manufacturer. All information must be followed. The DOT specifies regulations for marking, hydrostatic testing at the time of manufacture, and re-qualification of cylinders at specific time intervals depending on the design type of the cylinder. Requalification of cylinders can only be legally performed at retest facilities which have been issued retest identification numbers by the DOT. The re-qualification of cylinders requires a visual inspection, both internal and external, a hydrostatic test, marking or labeling and maintenance of proper records of the re-qualification. Re-qualification of SCBA cylinders is required with a frequency depending on the design type of cylinder.

Generally, composite cylinders (those having a metal core wrapped in non-metal materials such as Kevlar or fiberglass composites) are re-qualified every three years and all-metal cylinders are re-qualified every five years. The organization or cylinder owner and retest facility are required by DOT to know how often to have the re-qualification performed. DOT compliant composite cylinders have a maximum service life, usually fifteen years, as specified by the exemption issued to the cylinder. The service life of all-metal cylinders is determined at the time of re-qualification. If the cylinder passes the re-qualification, it can be used until the cylinder shows no external damage or until its next re-qualification.

Before each use of the respirator, the hydrostatic test date on the cylinder should be checked to ensure that it is current. Cylinders which are past due for DOT re-qualification should be immediately removed from service until they are re-qualified.

Damage and wear of cylinder components will affect cylinder service life. The cylinder assembly (cylinder, gauge, and valve) should be inspected before each use to ensure that it is functional. NFPA 1852, Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA), 2002 Edition, contains recommended NFPA procedures for SCBA cylinder maintenance.

Cylinders should be examined for damage and wear before each use. Damaged cylinders must be immediately removed from service until adequately repaired. Signs of wear or damage which can affect service life are color change of cylinder, burns, blistering, and deformities in the shape of the cylinder such as cracks, dents, weakened areas or chemical damage. Rolling cylinders to check for uniform cylindrical shape is a common practice [Fire Department New York, 2004].

The criteria for conducting a visual inspection of the cylinders, including quantification of surface damage, are available, upon request, directly from the cylinder manufacturer or the SCBA manufacturer.

The respirator manufacturer can provide specific guidance on reading and interpreting the DOT markings on cylinders and how the hydrostatic test date markings are updated when a cylinder is requalified. Among the DOT marking requirements which users should be familiar with are:

1) Hydrostatic Test Date

The hydrostatic test date is the date the cylinder was hydrostatically tested and considered qualified for use. The DOT also specifies regulations for the periodic re-qualification of cylinders. The hydrostatic test dates appear on each cylinder in compliance with applicable DOT regulations. It is generally a month, a certification unique inspection symbol and a calendar year.

2) Cylinder Pressure Rating

Cylinder pressure rating is specified by the manufacturer to be generally either 4500 psig, 3000 psig or 2216 psig. The cylinder pressure rating on the cylinder must be checked against the manufacturer's UI and the SCBA in use to ensure it is compatible with the SCBA system. Under select OSHA provisions interoperability between like pressure ratings but different SCBA manufactured air cylinders is possible on the incident scene.

3) DOT Exemption Number, for Composite Cylinders or Specification Number, for all-metal cylinders

The DOT exemption number or specification number corresponds to specific DOT regulations for cylinders, including retests and service life. All retesters, cylinder owners, and inspectors should be aware of any and all retest requirements and service life requirements pertaining to cylinders they handle.

- Service Life of Facepiece

All manufacturers' guidance on criteria for facepiece service life must be followed. The facepiece should be inspected before each use to ensure that it is functional.

Facepiece service life is affected by time, exposure event, operator maintenance and number of uses. The elastomeric material of the facepiece must remain pliable to provide the best seal to the sealing surface of the face. Elastomeric materials of facepieces can become cracked, frayed, and loose elasticity over time. Cracks, tears, holes or distortions of the facepiece may result from routine use or improper storage. Headstraps and head harness components should be replaced when broken, have lost elasticity, or have excessively worn serrations on the head harness which might permit slippage. Broken and malfunctioning buckles should be replaced. Facepieces with cracked

or badly scratched lens should be removed from service repaired or disposed.

Other components / accessories found on the facepiece which may need to be replaced or repaired are hydration devices, spectacle (glasses) inserts, Heads-Up-Display systems, speech diaphragms, and communications devices which electronically amplify the speaker's voice or send transmissions. Hydration devices, also known as drink tubes, currently do not exist in any CBRN approved SCBA, but may be available for future CBRN SCBA approvals.

- Service Life of Remaining SCBA Hardware

Additional or remaining SCBA components which must be inspected prior to each use are the backframe and harness assembly, hoses, EOSTI indicators, regulators, and system accessories. Damaged or mal-functioning hardware should be repaired or replaced by qualified personnel prior to use. The SCBA manufacturer may specify service life information for particular components in the manufacturer's UI. When this information is available from the manufacturer, it should be followed.

b. CBRN SCBA Features which Indicate Air Cylinder Rated Service Time

- Heads-Up Display
- Pressure Gauges
- End of Service Time Indicators

c. Use Life Cautions and Limitations Relating to Chemical Warfare Agent Exposure

NIOSH CBRN Caution and Limitation 'U' listed on the NIOSH approval label contained in the manufacturer's user instructions states:

> U- "The respirator should not be used beyond 6 hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation."

This statement means that following use in an environment which contains confirmed chemical warfare agents of the G-, V-, H-, or L- series (nerve or blister agents), in liquid or vapor form, the NIOSH approved CBRN SCBA must be removed from service and disposed of following **6** continuous hours of use after the initial confirmed exposure. The SCBA should not be reused and should be decontaminated and disposed of in a manner that is consistent

with the type of contamination and any local, manufacturer recommended government regulations governing contaminated items.

Confirmed CWA contamination presence is the key to determining the 6 hour start point of contamination on a CBRN SCBA. Therefore, instruments designed to detect, at stated concentration levels, are required to be on the terrorism site. Once detection confirms the agent type and quantity present, the CBRN SCBA use life of 6 hours starts. The 6 hour use life rule means **6 continuous hours** in a single shift, day, or event. It does not mean 6 individual one-hour exposures in one shift or one day, nor does it mean six different one hour exposures over the course of six different days. 6 continuous hours stop at the 5 hour, 59 minute and 60 seconds mark.

Use beyond the 6 hour mark of continuous use in a confirmed chemical warfare agent (CWA) incident goes against the NIOSH Caution and Limitation "U". However, in real world use the incident commander at the scene of a CWA incident may be confronted with the decision to implement use beyond the 6 hour mark. For example, the need to rescue and recover victims combined with a supply shortage of new CBRN SCBA units at the scene could present such a need. Use of a contaminated CBRN SCBA beyond the 6 hour mark may put responders at risk to possible exposure of CBRN agent which could permeate the contaminated CBRN SCBA. The incident commander must determine that at the 6 hour mark if the possibility of agent permeation has been negated by immediate and technical decontamination techniques.

Responders must also be aware of the possibility of indirect contamination by liquid or vapor CWAs which are also considered in the 6 hour use life rule. Indirect contamination may occur, for example, when CBRN SCBA are used in downwind areas from the response site or a liquid CWA contacts a unit through direct or indirect contact with other responders, victims, or equipment, outside of the target area. The 6 hour use life rule should be obeyed even if the SCBA is contaminated indirectly. However, the incident commander may determine, based on the type and concentration of CWA exposure and immediate technical decontamination techniques that modification to the 6 hour use life rule is possible.

NIOSH CBRN caution and limitation 'T' listed on the NIOSH approval label contained in the manufacturer's user instructions states

> T - "Direct contact with CBRN agents require proper handling of the SCBA after each use and between multiple entries during the same use. Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, dispose of the SCBA after decontamination."

In relation to the 6 hour use life rule, this limitation states that if contaminated by a liquid chemical warfare agent, the SCBA should be disposed of after decontamination. The limitation warns against reuse after a liquid exposure due to the persistency of some CWA liquids, for example HD is highly persistent as a liquid. In the case of a CWA liquid exposure, use beyond the 6 hour mark is highly cautioned against even when rapid technical decontamination can be performed. Decontamination should be performed in all cases for all confirmed CWA exposures, even if the CWA is considered non-persistent as a vapor, such as the case with GB. Even non-persistent CWAs vapors can permeate into and remain in materials if exposure concentrations are high, such as in a confined space. CWAs are can also be airborne in the form of liquid aerosols which are small liquid particles and not in true vapors states.

NIOSH Interim Recommendations for Firefighters and Other First Responders for the Selection and Use of Protective Clothing and Respirators Against Biological Agents, DHHS (NIOSH) publication number 2002-109, states *decontamination of protective equipment and clothing is an important precaution to make sure that any particles or contamination that might have settled on the outside of protective equipment are removed before taking off gear. Decontamination sequences currently used by hazardous materials teams should be used as appropriate for the level of protection employed. Equipment can be decontaminated using soap and water as part of a removal process, and 0.5% hypochlorite solution (one part household bleach to 10-parts clean water) can be used as appropriate or if gear has any visible CBRN contamination. Note that bleach may damage some types of equipment. After doffing all PPE, emergency response workers should shower using copious quantities of soap and water in a safe non-contaminated area.*

e. Rationale for Use Life CBRN SCBA Cautions and Limitations

CBRN SCBA with confirmed chemical warfare agent contamination may not provide their intended full level of protection to users if used beyond the NIOSH 6 hour recommended use-life limitation. The rationale for the 6 hour use life limitation is developed from laboratory tests evaluating penetration and permeation resistance of complete dynamically operating CBRN SCBA systems to GB vapor and HD vapor and direct contact with HD liquid droplets. The 6 hours of testing requires the SCBA to be refreshed with clean air essentially 5 times over the spans of one test trial. This translates into the possibility that an air cylinder is replenished more than once in the use life of a CBRN response.

NIOSH testing utilizes a mechanical breathing pump interfaced with a SMARTMAN zinc manikin headform wearing an operating SCBA in an exposure chamber. The air cylinder is not present during this SCBA

systems test, only the cylinder neck valve assembly and a tooled adapter torqued to a pressurized air source line are used.

For primary testing criteria, Acute Exposure Guideline Levels (AEGLs)-Level 2 one-hour level is used as the maximum breakthrough. But in addition, to verify that potentially high brief 'peaks' do not exceed levels of concern, peak concentrations identified in the test results are also evaluated against AEGL Level 2 10-minute levels, i.e., peak concentrations as measured in the test protocol, do not exceed the higher 10-minute level [Niemeier, Richard, 2001]. AEGL are established by a National Advisory Committee for the US Environmental Protection Agency and the National Research Council represent threshold emergency exposure limits for the general population, including more susceptible portions of the population and are applicable to emergency planning and decision making.

The AEGL values are agreed upon through rigorous scientific discussion, consensus and subsequent review in a transparent process by the public, other scientists and the National Academy of Sciences. AEGLs address various degrees of severity of toxic effects that are represented by AEGL 1, 2 and 3. Each of these levels represents the lowest estimate of a concentration above which a specified effect might be observed in an exposed population. AEGL-Level 2 values are the most appropriate threshold exposure limits (breakthrough) values for GB and HD testing since they ensure no significant respiratory or long-lasting effects will result if approved systems are properly worn [Niemeier, Richard, 2001].

The duration of each test for each agent is 6 hours. 6 hours is used because the most credible event was determined by a joint NIOSH/RDECOM analysis and is based, not on a worst case threat, but on a most likely to occur terrorist action. Toxicological analysis is used to define the required level of protection the SCBA must be capable of providing. 6 hours consists of 30-minutes of exposure followed by 5.5 hours of natural decay. Due to the time-limit capacity of SCBA air cylinders being less than one hour, approximately 45 to 30 minutes depending on the physiology and work rate of the wearer, the overall one time exposure of personnel and SCBA equipment is expected to be less than one hour. However, responses at the Pentagon site in 2001 showed the same SCBA being used with the same or different cylinder for upwards of 12 hours per shift. SCBA were in short supply and responders going off shift did not want to surrender their SCBA to oncoming responders due to shortage of SCBA and possible concerns over communicable health issues. Air supply sources were in short supply and responders had to spend time looking for air replenishment sources while managing the cylinder air on site. The use of quick charge and other methods for cylinder air replenishment were used [Arlington County After Action Report, 2001]. The goal is to identify existing SCBA respirators that can ensure that overall physical and chemical safety is maximized. 6 hours

achieves that initial goal. Only real world response(s) to a CBRN incident will tell if it is adequate.

Both GB and HD are considered to be reasonable challenge agents given their extreme toxicity relative to industrial chemicals, their permeation and penetration characteristics, their relative ease to produce and their worldwide availability in thousands of metric tons. The test parameters for the HD test are the application of a maximum of 43, 20-ul liquid droplets initially and then undisturbed for the entire 360-minute (6-hour) test duration followed by an HD agent vapor concentration of 300 mg/m^3 generated during the initial 30-minutes of the 6-hour test. HD was selected because of its permeation characteristics. HD is a linear molecule and permeates most materials faster than GB. HD is an agent of choice to evaluate permeation of SCBA even though its vapor toxicity in a liquid state is less than that of nerve agents.

The test parameters for the GB test are 2,000 mg/m3 of vapor/aerosol generated for the initial 30 minutes of the 6 hour test. GB was selected because it is the most volatile of the nerve agents, having a volatility of 22,000 mg/m^3 and it has low molecular weight and molecular branched configuration enabling it to permeate through SCBA materials more readily than other G series or V series nerve agents. Scientific studies on dogs and rates indicate that exposures to 0.001mg GB/ m^3 for up to 6 hour per day are unlikely to produce any signs of toxicity. GB is representative of the nerve agents; other nerve agents include GA (tabun), GD (soman) and VX. GB molecular configuration (108 Angstroms) enables it to penetrate surface interfaces, seams, openings, crevices, overlaps, or dead spaces of SCBA materials. A liquid GB droplet test is not performed since GB is understood to be the most significant threat when aerosolized in aerial vapor dispersion rather than in a liquid droplet state. GB liquid evaporates at the similar rate to water and therefore presents a non-persistent, but highly toxic hazard that in a confined space requires both dermal and respiratory personal protection. Therefore, the GB vapor adsorbed on the surface of the SCBA is the source of penetration or permeation challenge used in the NIOSH certification tests.

A combination liquid-vapor test is used for the HD tests, wherein liquid droplets of HD are placed on selected areas of the SCBA and a vapor challenge of HD is introduced into the test chamber. The liquid droplets and vapor test the permeation resistance the respirator materials while indicating the integrity of the materials to withstand the persistent chemical effects of HD. Since the permeation effects of HD are essentially non-reversible, HD contamination remains at the molecular level and decontamination laboratory operations prove that high temperature water baths force HD out of material surfaces but do not force out all of the HD over a given period of reasonable water bath boiling exposures (4 hours to upwards of 72 hours or greater) Once an material exposed to a chemical warfare agent is

decontaminated down to what is termed the 'XXX' level, it is acceptable for processing as a hazardous waste to the waste site collection point for incineration [RDECOM Protective Equipment Team IOP No. 12, March 2004].

Chapter 6. User Guidance

A. Before Operations

i. Shipping: CBRN SCBA should be shipped in original manufacturer specified containers. Routine DOT hazardous material labeling for filled air cylinders is required. Special care should be given to ensure no excessive abuse of shipped containers occurs. Part numbers on original invoice should match CBRN SCBA part numbers of shipped order.

ii. Receiving:

Upon receiving a new CBRN SCBA, thoroughly check that all components and accessories are included in the shipment, the user instructions are present, the NIOSH CBRN SCBA label is present and the NIOSH CBRN SCBA paper insert is present in the UI. Match the individual component part numbers to the numbers listed in the respirator component matrix of the NIOSH approval label. The NIOSH approval label is provided with each set of manufacturer's user instructions. An example of a CBRN SCBA approval insert label is shown in Appendix C. NFPA 1852 requires baseline posi-check of the SCBA upon receipt. A copy of the manufacturer's posi-check results should be with the SCBA.

iii. Inspection, Maintenance and Storage:

This section provides guidance for the inspection, maintenance, and storage of CBRN SCBA. Users should **always** follow the manufacturer's suggested practices for inspection, maintenance, and storage of their individual CBRN SCBA model. A recommended reference is NFPA 1852 *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA),* 2002 *Edition.*

1) Inspection

General Criteria: It is critical that the user verify that all of the CBRN SCBA components listed on the NIOSH approval label provided with the user instructions are present, correctly installed, and free from visible deterioration, wear, and damage. All

guidance and recommendations made by the manufacturer within the user instructions provided with each individual CBRN SCBA model should be followed.

Specific Criteria: The following inspection procedures should be performed before each use of the CBRN SCBA. Sequence is per the manufacturer's UI and the listing may not be all inclusive.

Facepiece:

- Check the elastomeric material for pliability, damage, tears, and cracks. Ensure no material defects are present.
- Check that all head-harness straps are fully extended, functional, have not lost elasticity, and buckles properly function and are not damaged. Ensure the type of head harness, Kevlar or butyl matches the CBRN SCBA label by part number and material applicable to the NIOSH TC number for CBRN protection. If the part number does not match contact the manufacturer. Ensure a CBRN part number is used because if it is not, the same level of CBRN protection determined by the NIOSH approval will most likely not be attained if a non-CBRN part number is used.
- Check the lens for holes, cracks, scratches, heat-damaged areas, and a properly maintained locking ring and seal with the facepiece material.
- Check the second stage regulator exhalation holes or valve, where present, for proper seating to the facepiece, operation and debris.
- Check the regulator connection(s) for damage and proper function.
- Check that the functions of the Heads-Up-Display, if present, are properly functioning.

Backframe:

- Check that harness straps and backframe are free from cuts, tears, abrasions, and indications of heat and chemical-related damage. Ensure the NIOSH CBRN label and harness assembly label are present and readable.
- Buckles and fasteners should be checked for proper adjustment. Fully extend the harness straps.
- The cylinder retention system should be checked for damage and proper operation and to ensure that the cylinder is securely attached to the backframe.

Cylinder Assembly (cylinder, gauge, and valve):

- Check that the cylinder hydrostatic test date on the cylinder is current. Cylinders which are past due for DOT re-qualification should be immediately removed from service until they are re-qualified.
- Check the cylinder body for cracks, dents, weakened areas, indications of heat damage, discoloration and indications of chemical damage.
- Check the cylinder valve outlet sealing surface and threads for damage, wear and clear any debris found.
- Check the valve hand wheel for damage, proper alignment, and secure attachment.
- Check the burst disc outlet area for debris. Ensure they are clear.
- Check that the cylinder is fully charged to the manufacturer's specified pressure rating. Air cylinders should be maintained in a fully charged state but should not exceed the manufacturer's maximum recommended pressure. Air cylinders should be recharged when the pressure falls below 1/4 of the manufacturer's recommended full pressure level. Use the local SOP.
- If qualified, ensure neck cylinder valve assembly is fully serviceable, shows no bend in the neck valve or probe, if visible. Burst disc is visible and clean. Independent air pressure gauge internal to the neck cylinder valve is readable and showing proper air pressure when correctly torqued into the cylinder.
- Prevent dropping the assembled SCBA on the high pressure hose coupling adjacent to the neck cylinder valve assembly.

End-of-Service-Time Indicator (EOSTI):

- Check that all EOSTI function and alarm in accordance with the manufacturer's instructions.
- The inspection should ensure that the alarm functions properly by observing the alarm function (visual, audible, or vibrating signal) of a period of time.

Regulator

- Check the regulator controls, where present, for proper function. Ensure all CBRN markings are readable and that unique CBRN components are in place per the UI.
- Listen for any unusual sounds such as whistling, chattering, clicking, or rattling during operation.
- Check that the regulator bypass functions properly. Use the bypass and check for correct bled down.

Pressure Gauge

- Check that pressure gauges are functional and that the cylinder pressure gauge and the remote gauges read within 10 % of each other. The remote pressure gauge can be a mechanical gauge face or a visual signal continuously displayed as part of a facepiece HUD.
- Ensure any vent holes are free of debris prior to activation.

PASS (Personal Alert Safety System), if present

- Check all operating modes for proper function in accordance with the manufacturer's user instructions.
- Ensure batteries are available for operation per UI.

Final Pressure Check

- As the final inspection item, the entire SCBA shall be checked for pressure retention. This is accomplished by closing all regulator valves, opening the cylinder valve thereby pressurizing the SCBA, and then closing the cylinder valve.

- The system should hold pressure in accordance with the manufacturer's specifications after the cylinder valve is closed. Ensure the length of time is stated in the UI. Reopen the valve and observe gauge changes for proper movement and stability.

- Following the pressure check, the system pressure should be released per the UI.

2) Maintenance

All maintenance, repairs, and replacement of parts on an SCBA should be done by trained, qualified personnel. Following any maintenance procedures, a qualified person should verify that the SCBA has been assembled to the correct NIOSH approved configuration, which is printed on the NIOSH CBRN SCBA paper label insert of the user's instructions. All maintenance should be done in accordance with the manufacturer's user instructions or consultation with a manufacturer's representative.

3) Storage

- Respirators should be stored in a ready to use condition. This condition may be designed to protect them from excessive dust, excessive radiant sunlight, excessive heat transfer, incompatible damaging chemicals, or excessive cold and moisture as specified in the user instructions.
- Facepieces and exhalation valves should rest in normal positions. Impaired function may result if the facepiece elastomer is allowed to set in an abnormal position such as inside a turnout gear jacket, wedged in between a seat and seat storage area, with strap inadvertently over facepiece lens or exposed to the natural elements for an excessive amount of time.
- Non daily use respirators should be maintained for immediate use in the case of replacing a field deployed unit. Select user instructions recommend storing facepiece in clear plastic bags after drying and to keep them in storage cabinets. While this may not be a common practice, it is advisable that CBRN SCBA should be treated with additional care prior to first time use due to additional factors related to cost of repair, replacement and testing.
- The OSHA Respiratory Protection Standard [29 CFR 1910.134] allows for SCBA to be stored in compartments or in covers on fire trucks. Brackets that are mounted on a wall or to a stable surface (e.g. on a fire truck) may be used to store SCBA and thus may ensure that the respirator is secured, covered and not wedged in a constricted space that may produce facepiece distortion or air line compression.

iv. Integration of CBRN SCBA into Respirator Protection Administrator Program

1. Respirator Protection Program administrators have unique challenges when integrating CBRN SCBA into an existing respirator protection program or starting new respirator protection program.

2. While the CBRN SCBA retains many of the same program qualities of the standard traditional non-CBRN/industrial SCBA, new variables such as CBRN SCBA use life, CBRN SCBA decontamination, CBRN SCBA service life, CBRN SCBA Upgrade Kit integration, Administrative Label Markings on CBRN SCBA versus industrial SCBA, complete swap out of industrial SCBA for new CBRN SCBA and training relevant to new aspects of CBRN defense are likely.

3. "Mask division" service personnel of a fire department are best suited to fully integrate manufacturer specific warnings, cautions and alert messages pertaining to operation and maintenance of CBRN SCBA and Upgraded CBRN SCBA [Kreuger, November 2004].

4. Responders should be thoroughly trained on how to differentiate CBRN SCBA from non-CBRN SCBA if both types are available in the workplace.

v. Training

QUALIFIED AND SANCTIONED TRAINING ON ALL ASPECTS OF THE PROPER USE, EMERGENCY USE, USE LIFE and DISPOSAL of the CBRN SCBA IS RECOMMENDED.

The information in this guide is intended to be administered through a complete respiratory protection program as described in OSHA, 29 CFR 1910.134. A complete respiratory protection program covers criteria for selecting respirators, medical evaluations, fit testing, maintenance, inspection, cleaning, storage, worker training, and regular effectiveness evaluations of the program. The respiratory protection program is to be directed by a designated knowledgeable professional, the respirator program administrator. The respirator program administrator interacts with management and oversees all aspects of the respirator program and is available to the user as a resource for questions or concerns on respirator use.

The required training under the OSHA Respiratory Protection Standard [29 CFR 1910.134] includes:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protection of the respirator;
- What the limitations and capabilities of the respirator are;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- How to inspect, put on and remove, use, and check the face seal of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators

A valuable source of respiratory protection information relating to the OSHA Respiratory Protection Standard [29 CFR 1910.134] is available at the OSHA Respiratory Protection eTools website at: http://www.osha.gov/SLTC/etools/respiratory/index.html

vi. Air Sources

1. Air supply sources for CBRN SCBA do not differ from traditional industrial/non-CBRN SCBA programs.

2. CBRN SCBA require the same grade of air routinely used in industrial/non-CBRN responder/receiver workplace environments.

3. Non-Toxic Particulates in the Air Pressure Boundary. In the course of NIOSH CBRN SCBA certification testing, select CBRN SCBA produce particulates in the air flow pattern of the normal compliant operating SCBA. These oil or non-toxic particulates are detected by NIOSH in the live agent testing portion of the NIOSH CBRN SCBA certification program. Manufacturers that have high particulate counts are required to provide Material Safety Data Sheets stating what the health impacts are from the off-gassing particulates found in the air source of the SCBA or air lines of the SCBA prior to receiving a NIOSH CBRN SCBA approval letter.

4. Before use in a CBRN incident response, air sources should be fully compliant with all Compressed Gas Association requirements for Grade D air at the minimum.

5. CBRN contamination of air sources is best prevented by location of air sources remote from contamination. If air sources become contaminated, locate and procure uncontaminated air sources for re-supply operations.

6. DO NOT USE AIR CYLINDERS THAT CONTAIN OR ARE SUSPECT OF CONTAINING CONTAMINATED AIR.

7. Compressed 'gas'/air cylinders used with CBRN SCBA hardware are DOT certified and exempted and as such are not part of NIOSH CBRN SCBA certification testing. Only the cylinder neck valve assembly is tested and then it

is adapted to a high pressure or low pressure air line tooled adaptor and correctly torqued to the appropriate torque value provided by the manufacturer.

vii. Detection

1. CBRN agent and effects are not easily detected with monitoring technology available to emergency responders today. Most direct reading monitors have limited sensitivity and selectivity. Limits of detection are typically higher than exposure levels capable of causing harm to exposed emergency responders. The lack of selectivity or potential for response to interferences, may allow first responders and first receivers to make a determination that some CBRN agent is there. The identity of that something is best determined by more specific monitoring technology, like that typically found in laboratory based instrumentation at the county, state or federal public health or scientific research laboratories levels [Kennedy, Eugene: November, 2004].

2. Available qualitative and quantitative detection instruments can be maintained and at the ready to assist in assessing gross CBRN agent presence and providing a level of repeatable results qualifying the presence of CBRN agents on personal protective equipment, to include CBRN SCBA. However, the results from these instruments should not be used to determine "all clear" areas or quantify the type of contamination present. Examples are the M256A1 kit, M8 paper, M9 tape, APD 2000 and other hand held direct reading instruments may contribute to assessing the local contamination presence, however, laboratory chain of custody samples should be relied upon to do this for the highest level of accuracy attainable.

3. Detection/monitoring repeatable results are important in providing criteria to the incident commander in determining the start time of use life for a CBRN SCBA.

4. CBRN contaminant detection monitoring operations are necessary in before operations to ensure all available detection instruments are operational within manufacturer specifications and are pre-positioned to support ease of use.

5. The necessity to confirm either qualitatively or quantitatively monitoring in the presence of chemical

warfare agents is critical because without some form of detection, the incident commander must assume the "worst case" and consider all CBRN SCBA as contaminated from initial onset of incident response to a CBRN event. The practice may result in numerous CBRN SCBA respirators being discarded at the end of the first 6 hour period if detection measures are not fully qualified and implemented in support of hazard zone analysis, respirator selection and respirator use logic. Default timing concepts may be used if detection is not possible and may involve quarantine of suspected CBRN SCBA until monitoring results are available.

6. NIOSH CBRN SCBA use life limitation of one total 6-hour period following the initial confirmed exposure to a chemical warfare agent is highly variable if detection instruments are not used to identify that something is, at best, determined present. Sampling must be allowed to take place and evacuation of those samples to a more specific monitoring technology located in specific public health or federal government laboratories for accurate and reliable identification of contaminant(s) is warranted.

viii. Decontamination Preparation of CBRN SCBA

1. Individual emergency responders will benefit from the use of immediate decontamination processes that help in removing gross CBRN contamination from PPE and other surfaces.

2. While each CBRN incident will likely have different decontamination operations tempo, gross decontamination with plain water will likely be the most common decontamination process.

3. Depending on suitability and availability of individual decontamination kits for emergency responders, CBRN SCBA may benefit from emergency responders having local individual decontamination kits available to remove gross CBRN contamination at the time of exposure, if possible.

4. Caustic solutions of decontaminates, while routinely available, will deteriorate CBRN SCBA and other PPE.

5. Use of CBRN SCBA under disposable Tyvek suits in recent anthrax responses, allowed for the SCBA to be protected and the suit to be discarded without discarding the SCBA.

6. Adjusted pH bleach decontamination and methyl bromide processes may be more effective on porous surfaces than non-porous surfaces [Edgewood Chemical Biological Center and the EPA, November 2004]. CBRN SCBA are a combination of coated and non-coated non-porous material surfaces. Various bleach solutions may deteriorate some SCBA harness materials and may not be detectable by the wearer [MSA, 2004].

ix. Electronic Communications

1. CBRN SCBA are approved with specific communications accessories and before use operations should ensure communications platforms and accessories are mounted correctly and do not impede form, fit or function of the CBRN SCBA.

2. Before operations actions for communications products on CBRN SCBA should be conducted in accordance with local fire ground SOP, SOG or All Unit Circulars (A.U.C.)

x. Extreme Weather Conditions

1. CBRN SCBA being prepared for before operations in possible extreme weather conditions should be maintained per the manufacturer user instructions. SCBA user instructions contain the minimum use temperatures. If the UI does not state this, contact the manufacturer. Application of anti-fog coatings to the interior of the lens may be required prior to use in a cold temperature environment. Chemical warfare agent use is unlikely in cold temperatures. Follow the SCBA manufacturer UI.

2. Extreme weather conditions such as freezing temperatures are not ideal conditions for CBRN agent employment. HD in particular will literally turn solid at temperatures lower than 14.45 °C or 54.5 °F. However, as the temperature increases, HD that is present will melt and present a permeation and penetration hazard as it melts.

3. Confined spaces may present high temperature conditions and CBRN SCBA are designed to withstand appropriate high temperature exposures per NFPA 1981 compliance testing.

xi. Mix-Match of Non-CBRN and CBRN Parts

The CBRN SCBA approval is only maintained when the parts and accessories listed on the official NIOSH approval matrix maintained by NIOSH and the official NIOSH SCBA label issued with the manufacturer's user instructions are used. Crisis decision making necessary to save lives requires careful assessment of compatible NIOSH CBRN SCBA and industrial SCBA. Mix match of those two different types of SCBA will void the NIOSH approvals of both and may result in death or serious injury to the wearer. Only those parts listed in the approval matrix and repeated on the label can be used. Non-CBRN parts can not be substituted for CBRN parts. Further, a CBRN SCBA with substituted non-CBRN parts is not expected to provide the same level of protection as a correctly assembled CBRN SCBA using the specified parts in the approval matrix. Select manufacturers have color coded critical parts of a CBRN SCBA for ease in identification and reassembly.

xii. Interoperable and Interchangeable Compressed Air Cylinders

1. NIOSH CBRN SCBA are required to use specified compressed air cylinders listed on the NIOSH approval label.

2. Variations between NIOSH CBRN approved cylinder neck valve assemblies and NON-CBRN approved cylinder neck valve assemblies may exist. Interoperation or interchange of these neck cylinder valve assemblies is not recommended.

3. Like air pressure duration cylinders from different manufacturers are not recommended for interchange between NIOSH CBRN SCBA hardware.

4. Incident commander life saving conditions may dictate crisis response adjustment of these recommendations.

5. The use of any prototype universal cylinders and neck valve assemblies is not recommended at the time of publication. Universal cylinder neck valve assemblies have

been identified as one option for increasing interoperability between responders at the same incident site.

B. During Operations.

1. Donning. CBRN SCBA are expected to be put on or donned in clean or contamination free environments. To attain the proper respirator fit, seal and operational capability, end users should be trained, retrained and confident on how to use a CBRN SCBA before actual use. Users should know the UI thoroughly and practice donning, wearing and removing/doffing the CBRN SCBA to attain and maintain proficiency in a defined respirator protection program. CBRN contamination is itself unpredictable due to many variables. If as a CBRN SCBA user, you are caught off guard by a secondary or primary CBRN device explosion or spray or other source of contamination, close your eyes, hold your breath and don that CBRN SCBA facepiece and regulator as fast as possible. Placing the SCBA on your back should only be a priority after you have successfully donned and activated the CBRN SCBA. Use of the reduced profile maneuver in reverse may allow enough time to protect the respiratory system from exposure. Resume normal SCBA wear posture once situation is stable or if the requirement to evacuate the area is specified. Two-man rule may provide the required assistance to effectively don the SCBA when the facepiece is donned and activated separately before placing the SCBA on the back.

2. NOTE: Each individually manufactured CBRN SCBA may have unique donning measures required to be done before or during donning.

3. Recommend strict attention to the training conducted on the SCBA and regular reading of every page of the UI to ensure unique donning practices such as turning an AIR KLIC device counterclockwise to tighten it or ensuring a slide is debris free are done prior to donning the SCBA.

4. Use. Actual use after successful donning of the CBRN SCBA is dictated by incident response. If during use, the CBRN SCBA faceseal is broken, every effort should be made to escape the hazardous area. While escaping, attempt to regain the facepiece seal by doing the manufacturers facemask fit checks or other appropriate method. In CBRN contaminated environments, over pressure/positive pressure from the pressure demand SCBA may provide a level of protection, but CBRN certification tests have shown that a firm seal is the best measure to protect the breathing

zone during inhalation and exhalation rather than relying on positive pressure of a SCBA. Wearing a SCBA may mean having the SCBA harness on one's back with the facepiece in a standby hanging position on an equipment hook. And using the SCBA may mean having the facepiece donned and on air while the SCBA hardware is on one's back or in the reduced profile maneuver posture. Specific use requirements are normally directed by local municipality binding procedures but generally, all emergency responders use SCBA when performing interior structural firefighting operations, performing interior structural emergency operations when toxic substances (CBRN included) or smoke are present, operating at outside positions where exposed to smoke or toxic substances (CBRN included), operating in confined spaces as defined in training bulletins or other standard operating guidelines or other than structural operations emergencies. Removal of CBRN SCBA under those conditions is also regulated by municipal binding documents, but generally, members operating in smoke or toxic atmospheres, CBRN included, should not remove SCBA facepiece except when in a clean area and the cylinder is depleted, the SCBA is malfunctioning so as to terminate air supply or in a life saving support mode with no risk to agent exposure. The risk of doing the last two exceptions in a CBRN environment is that the wearer could expose themselves or another responder to CBRN contaminates.

The sharing of CBRN SCBA between emergency responders is not recommended, whether it is the same facepiece that is being shared or the same entire SCBA or separate hardware. RIT response may require the sharing of respirators to allow escape. The practice of intermittent use of CBRN SCBA, going on and off air as situation indicates, while in smoke or CBRN contamination, is very likely to cause minor to major CBRN agent exposure resulting in acute or chronic health conditions or death. The use of "bite bars" or other devices designed to modify the air pressure boundary of a CBRN SCBA is not recommended. Emergency responders are cautioned against jeopardizing their health by non-compliance with NIOSH CBRN SCBA approval requirements, non-use of appropriate NIOSH CBRN approved respirator or by the possible use or miss-use of non-manufacturer specific modifications or adapters while using the CBRN SCBA.

3. End of Service Life Indicators. CBRN SCBA have standard NFPA and NIOSH EOSTI. Observation of them is highly recommended to ensure proper escape time is planned. Any local changes to the set EOSTI are the responsibility of the manufacturer and, if required, the organization that purchases the SCBA.

CBRN SCBA cylinders and components have expected service life and when contaminated, expected use life. Indicators relevant to both service life and use life should be observed. CBRN agent contamination use life indicator may use default timing procedures that rely on stop use at the 3- to 5-hour mark if on the job workplace detection methods are not present, present but not rapid enough or unreliable. Processing of SCBA is then may involve equipment quarantine until environmental sample results from the response scene are available one, two or three days later. Most likely, if sample results do not confirm type of contamination within one day, contaminated CBRN SCBA in the default timing pattern should be considered for discard due to potentiality for CBRN, specifically Chemical agent, permeation. Field-deployed SCBA upgraded to CBRN SCBA protection used for 6-hours in a CBRN chemical agent contamination response cannot have select retrofitted parts changed out and replaced and the CBRN SCBA made serviceable for use. Chemical agents do not distinguish between old or new parts, just the readiness of the material to penetration or permeation effects.

5. Cautions and Limitations Statements. NIOSH cautions and limitations (C&L) are lettered and cover the full spectrum of industrial and CBRN protection respirator approvals. They are routinely in alphabetical order and select letters may appear to be missing in NIOSH publications. They are missing because they are not applicable. For example, CBRN SCBA C&L are lettered I, J, M, N, O, S and then Q, R, T and U. Missing lettered C&L are not present because they are not assigned to that class of respirator due to non-applicability.

6. RIT or RIC/UAC. RIT operations for emergency responders wearing CBRN SCBA are crisis response directed. NIOSH does not provide CBRN Approvals to RIC/UAC female connectors or air sources, only to the integral RIC/UAC male connector located on the approved SCBA hardware.

7. Quick Fill/Quick Charge. Use of authorized accessory assembly air hose lines integrated with NIOSH CBRN SCBA approved hardware to quickly fill depleting air cylinders is not approved by NIOSH. However, NIOSH CBRN SCBA do have approved air line hose assemblies integrated per manufacturer applications but only the male connectors are NIOSH CBRN approved and the female quick fill connectors are not. If done, cylinder replenishment should be done in a clean protected area. And if done in a contaminated area, the cylinder replenishment should be upwind of the contamination and done as quickly as possible and only for life saving measures as directed by the incident commander. Rest cycles for responding personnel should be implemented. The most likely time for a responder to rest is when the air cylinder is being exchanged for a full cylinder [Kreuger, Michael, November 2004].

8. Purge-On. If a CBRN SCBA second stage regulator fails in the closed position, the red purge valve can be used to provide forced compressed air into the nose cup of the SCBA and bypass the second stage regulator. This procedure has not been done under NIOSH CBRN SCBA certification test procedures, however, NIOSH has demonstrated that the purge valve does maintain a safe air pressure boundary while un-engaged for those SCBA that have CBRN protection approval. Since the air pressure boundary at the purge valve does not allow GB, HD or corn oil penetration or permeation while the boundaries are pressurized, it is deduced that activating the purge valve will not have an adverse effect on the wearer while CBRN agent conditions are present. However, further research and testing is warranted in this area and each manufactured CBRN SCBA may likely vary on the effects generated by the purge-on action.
   NOTE: Purge-On should only be used for escape purposes. Emergency responders wearing SCBA should exit the scene when any type of malfunction is detected on the SCBA. Using the red purge valve, to by pass the second stage regulator will expend air at a faster rate from the compressed air cylinder of the SCBA.

9. Preparation for Escape. Purge-On or standard second stage regulator operations are recommended for CBRN SCBA use. Responders should exercise caution where gear bags or extra vital equipment is used in a CBRN response and may serve as a contamination spreader or carrier to clean or warm zone areas of the site. No CBRN contamination should go off site for any reason.

10. CBRN SCBA Failure. CBRN SCBA are not expected to fail provided the proper training is done and the respirator is worn correctly and used correctly. CBRN SCBA failure indicators may be rapid or slow. Catastrophic failure of a CBRN SCBA such as a neck cylinder valve breach, crack or discharge will require local mitigation techniques to contain the compressed air cylinder. Purge On action is recommended for escape purposes as soon as any sign of SCBA failure is detected or air supply is depleted. Purge On is expected to deplete integral air cylinder faster than second stage regulator operations. Two-man rule in effect at all times should assist in detecting pre-failure indicators. For long duration decontamination processes, supplied air line respirators with compressed air cylinder escape bottles are possible, provided the supplied air lines are kept clean of contamination. NIOSH does not approve SAR for CBRN protection operations.

11. CBRN SCBA Accessory Failure. CBRN SCBA accessory failures, due to malfunction or CBRN caustic effects, will cause that accessory to be discarded or rendered un-usable. Remaining SCBA hardware may still not be contaminated if only a specific accessory like the integral PASS device is splashed with liquid CBRN agent. Monitoring of the SCBA to determine

range of contamination splatter is warranted and rest of SCBA hardware may or may not be contaminated. Gross decontamination should nevertheless still be done with the emphasis that run off should not contaminate the rest of the supposedly clean SCBA.

12. Withdraw. CBRN SCBA use will support routine withdraw from the incident site in accordance with proper use of the SCBA UI.

13. Escape. As discussed, CBRN SCBA do not provide integral escape bottles or other means of providing escape air, except through use of the purge valve. Use of RIT to provide replenishment air is per incident commander authority and most likely will only be used to save a life and not extend work time.

C. After Operations

1. Unmasking Procedures. NIOSH CBRN SCBA should not be removed for any reason while wearer is still in a CBRN contaminated environment. An appropriate decontamination procedure should be selected based on the type of contamination, known effectiveness of the procedure, procedure cost, decontamination materials availability and ease of decontamination process implementation.

2. Doffing. Taking the CBRN SCBA off should only be done under strict contamination control measures if the SCBA is potentially or known to contain CBRN contamination of any type or mixture. If the CBRN SCBA is clean, doffing should be done in a safe area. Specific doffing sequences are provided in manufacturer UI. Please refer to the UI for proper doffing procedures.

3. Handling of CBRN SCBA. NIOSH CBRN C&L 'T' states direct contact with CBRN agents requires proper handling of the SCBA after each use and between multiple entries during the same use. If re-entry is decided while using the same CBRN SCBA, donning and use recommendations should be observed. Handling of contaminated CBRN SCBA should contain and mitigate all forms of CBRN contamination in accordance with the correct procedure relevant to the type of agent exposure. Universal handling procedures, used by hazardous material operators and in accordance with OSHA HAZWOPER requirements, are recommended. Actual handling of contaminated CBRN SCBA requires proper dermal and respiratory protection appropriate to the type of agent exposure. NIOSH CBRN SCBA and NIOSH CBRN APR are recommended as respiratory system protection during handling of contaminated CBRN SCBA equipment scheduled for disposal. Transfer of CBRN agents to adjacent equipment or personnel is possible. Care is needed to avoid contaminating clean equipment, gear bags or other equipment used in responding. If this equipment is not covered or isolated

from contamination off gassing or inadvertent exposure, the equipment can transfer contamination within the warm zone and must be prevented from going off-site at all costs. Controlling the spread of persistent contamination will be a challenging task requiring timely detection, timely quantification and timely decontamination. Improvised ladder pipe decontamination systems allow rapid set up of gross decontamination operations. The establishment of developed emergency decontamination corridor systems is expected to provide control measures to contain CBRN contamination. Local fire departments and federal response units employ rapid decontamination shelters and then enhance the decon shelters into a defined corridor as the site matures [Boston Fire Department, 2003].

4. Individual Equipment Decontamination. If known CBRN contamination is present on the CBRN SCBA, the most effective action to do is to go through gross decontamination wash-down to remove any type of CBRN agent. CBRN agent will not be neutralized but diluted to a level and physically washed off given equipment surfaces. This will limit CBRN agent penetration and permeation the sooner a wash-down is done. CBRN SCBA confirmed contaminated by available laboratory results may use default timing rules where the CBRN SCBA is used in known contamination for 3- to 5-hours, not exceeding 5- to 6-hours, if workplace detection is not possible. CBRN SCBA is doffed safely and quarantined until environmental results from the response scene are available. An appropriate decontamination procedure should be selected based on the type of CBRN agent exposure, the known effectiveness of the decontaminate or decontaminates, the cost of the decontaminate, the availability and lastly the ease of implementation and containment for incineration.

5. CBRN SCBA Facepiece Decontamination. In some levels of OSHA/EPA protective ensemble protection (Level B or Level A), only the facepiece, second stage regulator and hose assembly may be exposed to CBRN contamination. In the process of decontamination, decon methods of wash-down with copious amounts of water may limit the amount of CBRN contamination spread to the remaining areas of the CBRN SCBA that may not be contaminated. Qualitative detection measures may be available to say yes or no to the known effectiveness of the decontamination operation, however, public health laboratory results should provide confirmation of decontamination operations.

6. CBRN SCBA Cylinder and Hardware Decontamination. For biological response, latest EPA guidance calls for use of adjusted pH bleach on hard surfaces. See the link for additional information on adjusted pH: http://www.epa.gov/pesticides/factsheets/chemicals/bleachfactsheet.htm
A CBRN SCBA used in a biological response may be decontaminated using soap and water and a neutral 0.5% hypochlorite solution. This solution, close to but not above pH 7 and 5,000 to 6,000 parts per million in strength

can be prepared by mixing one part bleach (5.25%-6.00%) to one part white vinegar, to eight parts clean water. Bleach and vinegar are not combined together at any point in time; rather some water is added to the bleach, then vinegar and then the rest of the water. The pH of the solution must be tested routinely with a paper pH test strip. Treated surfaces must remain in contact with bleach solution for 60 minutes and repeated applications or emersion will be necessary to keep the surfaces wet. Also specific CBRN agent decontamination methods are available by using the CDC search engine at http://www.cdc.gov/az.do#S

7. Detection Methods In Support of Decontamination Operations. The current point source or direct read quantitative monitors available for CBRN detection is very limited. Most of the available technology has limited sensitivity and selectivity. Detection methods using laboratory results to confirm the effectiveness of decontamination is likely the best recourse. Qualitative monitoring devices such as US Army M-8 paper, M-9 tape, M256 kit, M256A1 kits, CAM, ICAM, ACADA or other progressive detection platforms may not provide the degree of quantification necessary to fully determine CBRN agent presence or absence. Rely on repeatable results from certified laboratories and use qualitative monitoring devices to help in establishing what equipment and personnel to sample for agent contamination sources.

8. Recommendations for Disposal. CBRN SCBA, once decontaminated to the best level possible requires special handling for disposal. Users of CBRN SCBA will not have resources to bring confirmed CBRN contaminated SCBA equipment to regulatory HAZWOPER levels of agent presence. Users should ensure CBRN SCBA are triple bagged in plastic, labeled with type of agent or agents contaminated with and the amount of decontamination solution and type used to remove gross contamination. Amount of exposure time for the contaminated SCBA and the concentration and amount of CBRN contamination is also beneficial information relative to disposal. Local and state disposal procedures for specific CBRN agent contamination should be followed.

9.Cleaning and Sanitization of NON-CBRN Contaminated SCBA. Recommended cleaning and sanitization procedures are located at http://www.cdc.gov/niosh/respcln.html

Chapter 7: Integration of CBRN SCBA with Protective Suit Ensembles or Protective Suits.

The following links contain relevant information pertaining to protective suit ensembles and respirator integration for CBRN response.

Biological: Go to
http://www.bt.cdc.gov/documentsapp/Anthrax/Protective/10242001Protect.asp

Chemical: Go to
http://www.bt.cdc.gov/agent/agentlistchem.asp

Radiological: Go to
http://www.bt.cdc.gov/radiation/pdf/MassCasualtiesGuidelines.pdf

1. Chemical Suit Pass-Thru Device

    a. CBRN SCBA, with approved auxiliary hose line assemblies, may interface successfully with specific chemical suit pass thru devices. These pass-thru devices allow airline connections to "pass through" designed suit opening and consist of airline pigtail designs such as Hansen, Schrader or Foster connectors.
    b. A special adapter from select manufacturers is available for Level A suits.
    c. Airline pigtail or auxiliary hose line assembly present on NIOSH CBRN SCBA may allow CBRN SCBA to have airline connections while in Level- A.
    d. Use of chemical suit pass thru device is situation dependent and at the discretion of the incident commander. Currently, NIOSH does not issue CBRN protection approval to chemical suit pass-thru devices, however, they are components on the non-CBRN/industrial NIOSH certified SCBA assemblies. Further, any air supply line and fittings must be approved as a component of the SCBA under 42 CFR Part 84. No interchangeability between manufacturers is recommended.

2. Expected Protection from Suit Ensembles

    a. CBRN SCBA used in conjunction with a new Level A ensemble are expected to stay contamination free, dependent on the quality assurance testing of the suit and compliance to a NFPA standard has been met.

    b. Use life of a CBRN SCBA does not start unless the protective suit ensemble is breached and allows minor to significant agent entry. Having a CBRN SCBA on under a Level A suit does not change the use life since the suit can protect the CBRN SCBA from splash and vapor hazards, provided it is compliant to current available third party CBRN consensus standards such as NFPA 1994 or 1991.

    c. Real time methods for determination of the start of exposure will rely on public health laboratory or federal laboratory confirmation of CBRN agent presence on the protective suit ensemble or the CBRN SCBA.

d. CBRN SCBA are intended to be discarded after use per applicable NIOSH cautions and limitations. Protective suit ensembles and accessories should be discarded in accordance with manufacturer and local municipality procedures.

e. Doffing of protective suit ensemble should not adversely impact the sealing properties of the NIOSH CBRN SCBA, provided doffing actions are not overly severe. Respirator seal maintenance should be maintained while doffing protective suit ensembles.

f. Explosive Ordnance Detachment (EOD)/Bomb Squad SRS-5 suits are designed to provide chemical and biological protection during low threat explosive ordnance detachment or improvised explosive device disposal operations involving CBRN agents. Select NIOSH CBRN SCBA are compatible for use with the SRS-5 EOD suit to provide respiratory protection. SCBA are worn external to the bomb suit. Go to http://www.med-eng.com/medeng_products_en/medeng_products_display_product.jsp?pID=5 for additional information on the SRS-5 EOD suit.

g. Protective suit ensembles or configurations used in hazardous waste operations (HAZWOPER) and commonly known as OSHA/EPA Level A, B, C and D are designed to provide increasing levels of dermal and respiratory protection from vapor, liquid, aerosol and particulate CBRN contamination. Levels A and B, provide higher levels of respirator and protective equipment protection than levels C and D. CBRN SCBA can be worn in Levels A or B and some crisis event commanders may weigh the mission risk and opt to use CBRN SCBA in Level C for a specific response. CBRN SCBA is designed by manufacturers to be worn with or without protective suit ensembles. CBRN SCBA are approved as stand alone respiratory protection devices and not in tandem with any protective suit ensemble or suit sub-component.

h. Integration of CBRN SCBA and non-CBRN SCBA respirators with firefighter turn out gear, law enforcement field gear, EPA Level A, B, C and D ensembles, NFPA 1994 class ensembles or any other dermal protective barrier deemed mission capable by the incident commander or unified commander is a likely reality for a national or international response to a CBRN terrorism incident. Currently, respirator manufacturers outfit SCBA with compatible accessories such as pass thru devices and Rapid Intervention Team or Crew/Universal Accessory Connection accessories that support SCBA compatibility with protective suit ensembles and portable air sources. Use of these compatible accessories for CBRN incident response is at the discretion of the incident commander or lead federal agency officer in charge.


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APPENDIX A. Acronyms and Definitions

ACRONYMS

AEGL - Airborne Exposure Guideline Level (National Research Council and Environmental Protection Agency)
APER- Air-Purifying Escape Respirator
APF —Assigned Protection Factor
APR- Air-Purifying Respirator
BA- Breathing Apparatus for commonly known as a SCBA respirator
CBRN—Chemical, Biological, Radiological and Nuclear
CBRNE - Chemical, Biological, Radiological, Nuclear or Explosives
CDC - Centers for Disease Control and Prevention
CGA – Compressed Gas Association
CWA—Chemical Warfare Agent
Decon – Decontamination
DHHS - Department of Health and Human Services
DHS- Department of Homeland Security
DOT – Department of Transportation
EOD – Explosives Ordnance Detachment
EOSTI- End of Service Time Indicator
EPA - Environmental Protection Agency
FFPE—Fire Fighter Protective Ensemble (Bunker Gear / Turnout Gear)
GA- Tabun (nerve agent)
GB —Sarin (nerve agent)
GD- Soman (nerve agent)
GF- Cyclohexyl Sarin (nerve agent)
HAZMAT- Hazardous Materials
HAZWOPER - *OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120)*
HD —Distilled sulfur mustard sulfur (blister agent)
HN-1, HN-2, HN-3- Nitrogen mustards (blister agents)
HSRB – Human Subject Review Board
HUD – Heads-Up Display
IAB - InterAgency Board for Equipment Standardization and Interoperability Working Group
ICS / IC – Incident Command System, Incident Commander
IDLH - Immediately Dangerous to Life and Health
IND and ICD - improvised nuclear device and improvised chemical device
ISEA – International Safety Equipment Association
L, L-1, L-2, L-3 - Lewisite (blister agents)
LANL – Los Alamos National Laboratory
LAT – Live Agent Test
LED - Light Emitting Diode
Level A, B, C, and D – OSHA/EPA defined levels of personal protection
LRPL—Laboratory Respirator Protection Level

MIIS – Monterey Institute of International Studies
MIPT - National Memorial Institute for the Prevention of Terrorism
MUC – Maximum Use Concentration
NFPA —National Fire Protection Association
NIOSH- The National Institute for Occupational Safety and Health
NIST - National Institute for Standards and Technology
NP – Non-persistent
NPPTL- National Personal Protective Technology Laboratory
OSHA – Occupational Safety and Health Administration
PAPR – Powered Air-Purifying Respirator
PASS - Personal Alert Safety System
PEL – Permissible Exposure Limit (OSHA)
PPE – Personal Protective Equipment
QLTF - Qualitative Fit Test
QNFT - Quantitative Fit Test
RDD / R-IED - radiological dispersive device / radiological improvised explosive device
RDECOM— US Army Research, Development and Engineering Command
REL- Recommended Exposure Limit (NIOSH)
RIC/*UAC* - Rapid Intervention Crew /Company Universal Air Connection System
RIT – Rapid Intervention Team
RKB – Responder Knowledge Base
RSA - Refugee Staging Area
SBCCOM— US Army Soldier and Biological Chemical Command, now RDECOM
SCBA—Self-Contained Breathing Apparatus
SCER – Self-Contained Escape Respirator
SEI —Safety Equipment Institute
SMARTMAN - Simulant Agent Resistant Test Manikin
TIC —Toxic Industrial Chemicals
TIM - Toxic Industrial Material
UI – User Instructions or Operations Manual
VX- VX (nerve agent)

DEFINITIONS

Agent—A force or substance that causes change or effects on an exposed substrate.

Airborne Exposure Guideline Level (AEGL) – Published by the National Research Council and Environmental Protection Agency, AEGL limits characterize the risk to the general population during a one-time accident and emergency scenario with time limits not to exceed 8 hours. The AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours.

Assigned Protection Factor (APF) — The minimum anticipated workplace level of protection by a properly functioning respirator or class of respirators to a percentage of properly fitted and trained personnel. The maximum use concentration of exposure for a

respirator is generally determined by multiplying a contaminant's occupational exposure limit (OEL) by the APF assigned to a specific class or type of respirator (MUC=OEL x APF). An occupational exposure limit (OEL) can be a NIOSH recommended exposure limit (REL), an OSHA permissible exposure limit (PEL), a short term exposure limit, ceiling limit, peak limit, or any other exposure limit for a hazardous substance. The APF of both a CBRN SCBA and non-CBRN 'traditional' SCBA is 10,000.

Biological Agents Biological agents are bacteria, viruses, or the toxins derived from biologic material. Airborne biological agents could be dispersed in the form of liquid aerosols or solid aerosols (a powder of bacterial spores, for example). Biological agents are classified according to biological type, use, operational effects and physiological actions. Biological agents can be classified as pathogens, toxins, or other agents of biological origin, such as bioregulators or biomodulators.

Blister Agents (Vesicants)—Vesicants are highly reactive chemicals that combine with proteins, DNA, and other cellular components to result in cellular changes immediately after exposure. The most commonly encountered clinical effects include dermal (skin erythema and blistering), respiratory (pharyngitis, cough, dyspnea), ocular (conjunctivitis and burns), and gastrointestinal (nausea and vomiting). Blister agents are H (sulfur mustard), HD (distilled sulfur mustard), nitrogen mustard (HN-1, HN-2, HN-3) and Lewisite (L, L-1, L-2, L-3).

Bunker Gear/Turnout Gear/Fire Fighter Protective Ensemble (FFPE)—Protective clothing for structural firefighters' that is designed to protect its wearers from the thermal environments experienced during firefighting.

CBRN Protection — An NIOSH designated respirator approval protection for chemical, biological, radiological and nuclear agents.

CBRN Self Contained Breathing Apparatus (SCBA), open circuit, pressure demand—An atmosphere-supplying respirator for which the breathing source is designed to be carried by the user and found compliant to NIOSH industrial, NFPA fire protection and NIOSH CBRN standards and protocols.

Chemical Warfare Agents (CWA): Chemical warfare agents are agents specifically intended for military warfare application to kill, seriously injure or incapacitate people. In the context of the CBRN SCBA cautions and limitations T and U pertaining to equipment contamination, the chemical warfare agents are the nerve agents: GB (Sarin), GA (Tabun), GD (Soman), GF (cyclohexyl Sarin), and VX; and the blister agents: H (sulfur mustard), HD (sulfur mustard), nitrogen mustard (HN-1, HN-2 and HN-3) and Lewisite (L, L-1, L-2 and L-3).

Class 1 Ensemble— In accordance with NFPA 1994 Standard on Protective Ensemble for Chemical/Biological Terrorism Incidents (current 2001 Edition) which sets performance requirements for protective clothing used at chemical and biological terrorism incidents, Class 1 ensembles offer the highest level of protection. Class 1

ensembles are intended for the worst case circumstances, where the substance involved creates an immediate threat, is unidentified and of unknown concentration. Such situations would occur where these is still an on-going release with likely gas/vapor exposure, the responder is close to the point of release, and most victims in the area appear to be unconscious or dead from exposure. Stay times in the hazard zone are likely to be very short and limited to the breathing air available from the SCBA.

Class 2 Ensemble—In accordance with NFPA 1994 Standard on Protective Ensemble for Chemical/Biological Terrorism Incidents (current 2001 Edition) which sets performance requirements for protective clothing used at chemical and biological terrorism incidents, Class 2 ensembles offer an intermediate level of protection. Class 2 ensembles are intended for circumstances where the agent or threat has generally been identified and where the actual release has subsided. Conditions of exposure include possible contact with residual vapor or gas and highly contaminated surfaces at the emergency scene. Victims in the area may still be showing signs of movement.

Class 3 Ensemble— In accordance with NFPA 1994 Standard on Protective Ensemble for Chemical/Biological Terrorism Incidents (current 2001 Edition) which sets performance requirements for protective clothing used at chemical and biological terrorism incidents, Class 3 ensembles offer the lowest level of protection. Class 3 ensembles are intended for use well after the release has occurred or in the peripheral zone of the release scene for such functions as decontamination, patient care, crowd control, and clean-up. Class 3 ensembles should only be used when there is no potential for vapor or gas exposure and exposure to liquids is expected to be incidental through contact with contaminated surfaces. Class 3 ensembles must cover the individual and it is preferred that this clothing also cover the wearer's respirator to limit its potential for contamination. Because these ensembles are intended for longer wearing periods, the use of air-purifying respirators with these suits is likely.

Cold Zone/Green Zone/Clean Zone—The uncontaminated area where workers are unlikely to be exposed to hazardous substances or dangerous conditions. This is the area where the command post and support functions that are necessary to control the incident are located. This is also referred to as the clean zone, green zone or support zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

Contaminated— The state of a CBRN SCBA when it has been used in a CBRN response environment. A contaminated CBRN SCBA must be handled, decontaminated, and disposed of in accordance with the NIOSH CBRN SCBA Cautions and Limitations Q, R, T, and U. A 6.0 hour continuous use-life limitation applies when the exposure is to a chemical warfare agent.

Decontamination— Decreasing the amount of contamination on any person, object or area by absorbing, neutralizing, destroying, ventilating, or physically removing contamination.

Dirty Bomb—A conventional explosive device that has been surrounded by or contaminated with some form of radioactive material.

Encapsulated Ensemble— The encapsulating ensemble provides liquid-tight vapor-tight, and/or gas-tight protection depending on design and compliance testing. The elements of an encapsulating ensemble are garments, hoods, gloves, and footwear that provide protection to the upper and lower torso, head, hands, and feet and completely cover the wearer and the wearer's SCBA or supplied air respirator.

Event of National Significance— Major events, as determined by the President of the United States, that are vulnerable to terrorism and other criminal acts.

Exposure— The condition of being subject to some detrimental effect or harmful condition.

Fit Factor: A quantitative measure of the fit of a specific respirator facepiece to a particular individual.

Fit Test: Means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

HazMat/HAZMAT Team—A hazardous materials response team organized and designated by the employer, that is expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

Hot Zone/Red Zone—An area immediately surrounding a dangerous goods incident which extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone. This zone is also referred to as exclusion zone, red zone or restricted zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)

Incident Command System (ICS) and Incident Commander (IC)—A system and command designate for managing emergencies.

Immediately Dangerous to Life and Health (IDLH): Conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health. (See Section h. Other Hazardous Atmospheres in Chapter 2 for more information on IDLH conditions).

Laboratory Respirator Protective Level (LRPL) Testing—A NIOSH CBRN respirator certification test using human test subjects to ensure that the facepiece seal interface between the test subject and the SCBA performs to an established NIOSH protection level in a quantified laboratory chamber filled with a specific amount of corn-oil aerosol particulates. This test is conducted using 11 exercise movements on a Los Alamos National Laboratory panel of facepeice sizes for human test subjects which approximates the facial shapes and sizes of the user population at the 95 percentile.

Level A Ensemble/Protection— The EPA personal protective equipment ensembles identified as Level A, B, C, or D are based on their levels of protection. These ensembles are listed in Appendix B of the OSHA HAZWOPER Standard 29 CFR 1910.120, and in the *NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (1985). **Level A** represents the greatest danger of respiratory, eye or skin damage from hazardous vapors, gases, particulates, sudden splash, immersion or contact with hazardous materials. A Level A ensemble consists of total encapsulation in a vapor tight chemical suit with self-contained breathing apparatus (SCBA) or supplied air and appropriate accessories.

Level B Ensemble/Protection— The EPA personal protective equipment ensembles identified as Level A, B, C, or D are based on their levels of protection. These ensembles are listed in Appendix B of the OSHA HAZWOPER Standard 29 CFR 1910.120 and in the *NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (1985). **Level B** situations call for the highest degree of respiratory protection but a lesser need for skin protection. It calls for SCBA or positive pressure supplied air respirator with escape SCBA, plus hooded chemical resistant clothing (overalls and long sleeved jacket; coveralls; one or two piece chemical-splash suit; or disposable chemical-resistant coveralls).

Level C Ensemble/Protection— The EPA personal protective equipment ensembles identified as Level A, B, C, or D are based on their levels of protection. These ensembles are listed in Appendix B of the OSHA HAZWOPER Standard 29 CFR 1910.120 and in the *NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (1985).Level C protection should be selected when the type of airborne substance is known, concentration measured, criteria for using air-purifying respirators met, and skin and eye exposure is unlikely. Periodic monitoring of the air must be performed. Level C ensembles include a full-face or half-mask, air-purifying respirator, Chemical resistant clothing (one piece coverall, hooded two piece chemical splash suit, chemical resistant hood and apron, disposable chemical resistant coveralls.),gloves and boots.

Level D Ensemble/Protection— The EPA personal protective equipment ensembles identified as Level A, B, C, or D are based on their levels of protection. These ensembles are listed in Appendix B of 29 CFR 1910.120 and in the *NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (1985). Level D is primarily a work uniform and is used for nuisance contamination only. It requires only

coveralls and safety shoes/boots. Other PPE is based upon the situation (types of gloves, etc.). It should not be worn on any site where respiratory or skin hazards exist.

Levels of Protection—Refers to the levels of respiratory and dermal (skin) protection that an ensemble provides. A level of protection refers to both the clothing and the respiratory devices inclusive. These levels are defined and accepted by response organizations such as the U.S. Coast Guard, NIOSH, and U.S. EPA.

Live Agent Test (LAT)—Common term used to describe a NIOSH CBRN respirator certification test that measures CWA permeation and penetration resistance against Sarin gas (GB) and sulfur mustard (HD) liquids and vapors.

Maximum Use Concentration (MUC): Maximum use concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC usually can be determined mathematically by multiplying the assigned protection factor (APF) specified for a respirator by the NIOSH recommended exposure limit (REL), permissible exposure limit, short term exposure limit, ceiling limit, peak limit, or any other exposure limit used for the hazardous substance.

National Institute of Occupational Safety and Health (NIOSH)/The Institute—NIOSH is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control in the Department of Health and Human Services.

National Personal Protective Technology Laboratory (NPPTL)— Part of NIOSH, the mission of NPPTL is to provide world, national and Institute leadership for prevention and reduction of occupational disease, injury and death for workers who rely on personal protective technologies ... through partnership, research, service, and communication. NPPTL operates the national certification program for workplace respirators used in all types of workplace environments.

NIOSH CBRN Approved—Is a NIOSH certification term that signifies specific respirator systems that have been evaluated, reviewed and approved/certified by NIOSH as providing an acceptable level of protection against chemical, biological, radiological, and nuclear agents. Approval authority authorized by existing policy of 42 Code of Federal Regulation, Part 84 (42CFR84) and the statement of standard that utilizes the three tier approval process for issuing a CBRN protection approval for a SCBA.

NIOSH Approved—Respirators and components that have been reviewed and certified by NIOSH in accordance with 42 CFR Part 84. Approval authority is set up by OSHA to cover all of industry and, therefore, issued approvals are industrial approvals.

Nerve Agents—Nerve agents consist of a group of very toxic organophosphate chemicals specifically designed for military warfare. Nerve agents are GB (Sarin), GA (Tabun), GD (Soman), GF (Cyclohexyl Sarin), and VX. Nerve agents cause effects on the human body by disrupting how nerves communicate and control muscles, glands, and organs.

NFPA 1981 Standard— Standard on Open Circuit Self-Contained Breathing Apparatus for Fire Fighters and Emergency Services Personnel. Updated every 5 years, it is part of the second tier of approval for the CBRN SCBA. Edition in effect at the time of CBRN approval letter is the edition the CBRN SCBA is compliant to.

NFPA 1991 Standard— National Fire Protection Association Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies. The NFPA 1991 vapor protective ensemble provides a minimum level of protection against adverse chemical vapor, liquid splash, and particulate environments during hazardous materials emergency incidents. Optional test criteria is available for chemical flash fire escape protection, liquefied gas protection, and chemical / biological terrorism agent protection (chemical / biological terrorism agent protection is also addressed in the NFPA 1994 standard).

NFPA 1994 Standard— National Fire Protection Association Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents. The NFPA 1994 Standard on Protective Ensemble for Chemical/Biological Terrorism Incidents (current 2001 Edition) sets performance requirements for protective clothing used at chemical and biological terrorism incidents. It defines three levels of ensembles (Class 1, Class 2, and Class 3) based on the perceived threat. The differences between the three classes are based the ability of the clothing design to resist the inward leakage of chemical or biological contaminants, the resistance of the materials used in the ensembles to chemical warfare agents and toxic industrial chemicals, the strength and durability of these materials. Ensembles are designed for a single exposure use, and consist of garments, gloves, and footwear. The NFPA 1994 Class designations should not be viewed as being equivalent to the OSHA protective clothing designations of Level A, B, C.

Non-encapsulated Ensemble— A type of liquid splash-protective ensemble that does not provide liquid-tight, vapor-tight, or gas-tight protection to the wearer and the respirator is fully exposed except for those portions that may be covered by the ensemble hood.

Non-Persistent— A common term used to describe the generally understood short duration time a chemical agent or any CBRN agent, remains on target or in the area.

Oxygen Deficient Atmosphere: An atmosphere which contains an oxygen partial pressure of less than 148 millimeters of mercury (19.5 percent by volume at sea level).

Persistent— A common term used to describe the generally understood long duration time chemical agent or any CBRN agent, remains on target or in the area. All factors such as weather, concentration, physical state, surface contaminated and temperature

should be considered in determining if a CBRN agent is in fact persistent and capable of presenting a long term hazard to responders.

Nuclear Agents— Particulate-borne radiation dispersed by detonation of an improvised nuclear device (IND) or high/low yield nuclear detonation. An IND could consist of diverted nuclear weapon components or a modified nuclear weapon. INDs require fissionable material—highly enriched uranium or plutonium—to produce nuclear yield.

Penetration— The act or process of penetrating, piercing, or entering. As it relates to CBRN testing, it is a term that means exposing the respirator to specific quantities of chemical warfare agent with the express intent to see if the agent is stopped or if it penetrates through air pressure boundaries or material interfaces into the breathing zone of the respirator. If it penetrates under laboratory ideal conditions, most likely it will penetrate under confined space or enclosed space exposure conditions.

Permeation— The action of passing through the openings or interstices of a substrate at the surface level or the molecular level. As it relates to CBRN testing, it is a term that means exposing the respirator to a specific quantity of chemical warfare agent with the express intent to see if the agent is stopped and runs off or if it beads up and starts to permeate through air pressure boundaries or material surfaces into the breathing zone of the respirator or respirator accessories. If the agent permeates under laboratory ideal conditions, most likely it will permeate under confined space or enclosed space exposure conditions.

Permissible Exposure Limit (PEL) - An enforceable regulatory limit set by the Occupational Safety and Health Administration (OSHA) on the amount or concentration of a substance in the air. PELs are set to protect workers against the health effects of exposure to hazardous substances and are based on an 8-hour time weighted average exposure.

Personal Protective Equipment (PPE)— Clothing and equipment used to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered at a hazardous waste site. PPE should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

Positive Pressure Respirator—A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Protective Suit Ensemble—The complete personal protective equipment outfit (i.e., respirator, gloves, boots, clothing, …) required for an event or task.

Radiological Agents—Particulate-borne radiation dispersed by detonation of a radiological dispersive device (RDD) or "dirty bomb."

Rapid Intervention Crew /Company Universal Air Connection System (RIC UAC) —A portable compressed air system consisting of compatible interfaces that allows

emergency replenishment of breathing air to the SCBA of down, disabled or entrapped emergency responders.

Rapid Intervention Team/Crew (RIT) — Designated firefighter search & rescue teams.

Rated Service Time—The manufacturer assigned value and a NIOSH approved rated time of duration assigned based on breathable air that a respirator uses linked to air consumption at a moderate work rate.

Recommended Exposure Limit (REL) – An occupational exposure limit recommended by NIOSH as being protective of worker health and safety over a working lifetime. RELs are time-weighted average concentrations for up to a 10 hour workday during a 40-hour workweek.

Refugee Staging Area/Area, Staging, Refugee (RSA) — Area where suspected or actual contaminated personnel are isolated away from the CBRN contamination source. RSA is in the red zone but upwind of the source and allows for contaminated personnel to get out of contamination but not out of the Red zone.

Respirator Protection Program— A written procedure used to ensure that respirators are properly selected, used, and maintained by identified personnel. The program is to be administered by a suitably trained administrator and the program elements must meet the criteria specified in the OSHA respiratory protection standard (29 CFR 1910.134).

Terrorist Event— Any violent act involving the potential to cause physical, mental, and/or financial harm to the victim of the act.

Toxic Industrial Chemicals (TICs)/Toxic Industrial Materials (TIMs)— a variety of chemicals used in various industrial processes which can kill, seriously injure, or incapacitate people.

User Instructions (UI) – A NIOSH recognized manufacturer publication required to be submitted to NIOSH as part of a certification application requesting NIOSH approval. The UI are included with every new purchase of a NIOSH approved respirator.

User Seal Check—An action conducted by the respirator user to determine if the respirator is properly seated to the face.

Use Life – Use limitation applying to the CBRN SCBA of a continuous 6.0 hour period beginning at the time of a confirmed exposure to a chemical warfare agent, after which the CBRN SCBA must be decontaminated and disposed of. Some variations on this rule are possible based on the decision authority by the incident commander or other authority commanding operations at the event site based on life saving priorities. Variations in the 6.0 hour use life rule may be necessary in the interest of victim rescue and recovery and the limited availability of new, uncontaminated CBRN SCBA at the site.

Warm Zone/Yellow Zone/Decontamination Zone— Area between Hot and Cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination. Also referred to as the contamination reduction corridor (CRC), contamination reduction zone (CRZ), yellow zone or limited access zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)

Appendix B. Frequently or Recently Asked Questions (FAQ)

1) **Is it always necessary to perform a "user seal check" on a CBRN SCBA respirator before each use?**

Yes. Please do not confuse a user seal check with a fit test. A negative or positive pressure user seal check is done by the wearer prior to entering a given workplace requiring respiratory protection. A fit test is a qualitative or quantitative respirator performance test done with a selection of respirators on a human subject and by the respirator program administrator sponsored by the employer. Performing a user seal check before entering a contaminated area is important to minimize contaminant leakage into the facepiece and to minimize leakage out of the facepiece that wastes air and reduces service time. User seal check procedures are located in Appendix B-1 of the OSHA Respiratory Protection Standard [29 CFR 1910.134]. Equally effective manufacturer's user seal check procedures, which are located in the manufacturer's user instructions specific to the model of respirator, are also acceptable.

The OSHA procedures are located at:
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9781

2) **How do I tell the difference between a NIOSH approved CBRN SCBA and a traditional industrial NIOSH approved SCBA, which is not approved for CBRN protection?**

Look to see if the CBRN Agent Approved label shown below is on the respirator harness assembly. If a respirator is CBRN-approved by NIOSH, it will carry this adhesive label. The label is required to be located on the backframe of the SCBA in a highly visible location. If this CBRN Agent Approved label is **not** on the SCBA, the device is **not** approved by NIOSH for use in CBRN environments. **Check the CBRN Agent Approved label!** The label may also contain the word 'Retrofit' denoting that the SCBA was a previously deployed traditional industrial NIOSH approved non-CBRN SCBA which has been upgraded to CBRN protection status.

The font size of the NIOSH label may vary between SCBA manufacturers and the exact location of the label on the harness assembly is also at the discretion of the manufacturer. CBRN SCBA may also have unique markings for specific manufactured production models which are voluntarily designated by the manufacturer. These unique markings, if present, are not required for NIOSH approval, but are provided for the benefit of the user to distinguish CBRN protected SCBA from non-CBRN protected models in the same workplace. Unique markings can consist of color-coded adhesive labels prominently displayed on visible components of the CBRN SCBA, use of the printed letters 'CBRN' to identify second stage regulators, use of the letters CBRN on the side of the backframe or inside the facepiece or embossed facepieces with the letters CBRN.

3) **Will a NIOSH approved SCBA that is not approved with CBRN protection protect me from CBRN agents?**

A NIOSH approved SCBA that is **not** CBRN approved (referred to as an industrial or traditional NIOSH approved SCBA) has not been tested for penetration and permeation resistance to chemical warfare agents as part of its NIOSH approval. Because many chemical warfare agents (CWA) are highly aggressive in terms of their penetration and permeation ability, the traditional non-CBRN SCBA should not be relied on to provide protection against Chemical Warfare or Terrorism Agents. For protection against CWA gas/vapors and liquid contact, a CBRN SCBA should be used. The traditional non-CBRN SCBA should be limited to use to for protection against industrial exposures.

The traditional industrial non-CBRN SCBA provides industrial levels of protection against industrial gases, vapors and particulate aerosols including biological (bacteria and viruses) and radiological and nuclear particulate aerosols. The traditional industrial SCBA also provides protection against unknown industrial atmospheres, industrial IDLH conditions, and oxygen deficient industrial atmospheres.

4) **Do I need to dispose of my NIOSH approved CBRN SCBA after use in a chemical warfare agent (CWA) contaminated environment?**

Yes. Following use in an environment with the confirmed presence of chemical warfare agents (CWA) including GB, GA, GD, GF, VX, HD, HN-1, HN-2 and HN-3 and Lewisite in liquid, aerosol or vapor forms, the NIOSH approved CBRN SCBA must be removed from service and disposed of following **6 continuous hours** after the initial confirmed exposure. The SCBA should not be reused following this 6 hour time period and should be decontaminated and disposed of in a manner that is consistent with the type of contamination and any government regulations governing decontamination of contaminated items. Some

variations on 6 hour use-life rule are possible at the discretion of the response scene incident commander or other appropriate authority and are discussed in this document in Chapter 6.

After use in an environment that **does not** contain CWAs, the respirator should be cleaned in accordance with recommendations from the manufacturer and current Centers for Disease Control and Prevention decontamination protocols.

5) **How long can I use my NIOSH CBRN SCBA at the scene of a response?**

The CBRN SCBA respirator should not be used beyond **6 continuous hours** after an initial confirmed chemical warfare agent (CWA) exposure in liquid, vapor or aerosol form to avoid possibility of agent permeation or penetration. Following the 6 continuous hour time period, the SCBA should be decontaminated and disposed of in a manner that is consistent with the type of contamination and any government regulations governing contaminated items. Some variations on this rule are possible and are discussed in this document in Chapters 5 & 6. If no CWAs are present, the SCBA should be used in accordance with the manufacturer's user recommendations for inspection, cleaning, and maintenance. If the SCBA was used in a response involving biological or radiological contamination, the SCBA will need to be decontaminated in accordance with manufacturer guidance and recommended CDC decontamination methods before reuse.

5) **Where can I find a list of NIOSH approved CBRN SCBA?**

A list of currently approved CBRN SCBA is available on the NIOSH, NPPTL web site at:

http://www.cdc.gov/niosh/npptl/topics/respirators/cbrnapproved/scba/

6) **Where are the user instructions specific for my CBRN SCBA model?**

Every NIOSH approved CBRN SCBA is sold with a printed copy of the manufacturer's user instructions plus a NIOSH CBRN SCBA label insert. If you do not have a printed copy of the manufacturer's user instructions contact the manufacturer or equipment supplier to obtain a current copy. Integration of CBRN related user instructions is at the discretion of the manufacturer. NIOSH is available to assist in locating correct user instructions.

7) **What hazards does the CBRN SCBA protect against? Which chemicals and particles, and at what levels?**

NOTE: Read Chapter 2, Design Requirements and Components, for a detailed explanation of protection provided by a NIOSH approved CBRN SCBA.

- *Airborne industrial chemicals*—Chemicals used in industrial applications existing in the airborne states of gases, vapors, and solid and liquid particulate aerosols.
- Specific *chemical warfare agents*—Protection is provided against GB (Sarin), GA (Tabun), GD (Soman), GF (Cyclohexyl Sarin), VX, HD (sulfur mustard), nitrogen mustard (HN-1, HN-2 and HN-3) and/or Lewisite (L, L-1, L-2 and L-3)
- *Particulate aerosols*—Solid or liquid chemicals are suspended in air. This includes protection against biological aerosols (bacteria and viruses), colloidal suspensions and particulates carrying radioactive isotopes.
- *Unknown atmospheres*—Atmospheres where the types of contaminants and their concentrations are unknown within the limitations of the SCBA.
- *IDLH atmospheres*—Atmospheres where the contaminant concentrations are known to be immediately dangerous to life or health (IDLH) within the limitations of the SCBA.
- *Oxygen deficient atmospheres*—Atmospheres known to contain less than 19.5% oxygen at sea level within the limitations of the SCBA.

8) How do I know if the facepiece is properly sealed to my face so I know I am protected?

You know this by conducting a correct user seal check that confirms the air tight seal interface between a correctly fitted and donned respirator and the physical dimensions of your clean shaven face. You should feel a slight vacuum pressure or overpressure when the negative or positive pressure user seal check is done and then you should detect no strange odors or sensations while breathing normally with the sealed respirator. With CBRN SCBA, fit testing as it is routinely done with special emphasis on maintaining serviceability of unique materials and components that make the SCBA CBRN compliant. This is normally done by adapting the SCBA facepiece to a negative pressure configuration and conducting quantitative fit testing with a calibrated fit test machine. Under OSHA, the respirator program administrator is responsible for managing the workplace respirator protection program and providing fit-tests to respirator users prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter to ensure continued, proper fit [29 CFR

1910.134(f)(2)]. Users should also undergo fit testing when changes in their physical condition could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight [29 CFR 1910.134(f)(3)]. The OSHA Respiratory Protection Standard [29 CFR 1910.134] mandates that facepieces, even for positive pressure units, be fit tested in the negative pressure mode. The respirator user should have the option to try different sizes of face pieces (for example: small, medium, & large) while undergoing initial and subsequent fit testing. The manufacturer can provide assistance by providing an adapter to test the SCBA facepiece in the negative pressure mode.

A user seal check is a method for determining whether a respirator has been properly donned (put-on) and properly adjusted to ensure a proper fit. Respirator users should perform a user seal check every time the respirator is donned, before entering a contaminated area, any time the user detects a seal breakage due to work rate and any time the respirator is doffed and re-donned due to hydration or rest cycles. A user seal check evaluates the seal of the respirator to the user's face by having the user put the facepiece under positive or negative pressure and noticing leakage. User seal check procedures are located in Appendix B-1 of the OSHA Respiratory Protection Standard [29 CFR 1910.134]. Manufacturer's user seal check procedures, which are located in the manufacturer's user instructions specific to the model of respirator, are also available and provide unique product insight to the workings of the respirator.

9) What type of training do I need to ensure that I can properly use a NIOSH approved CBRN SCBA respirator?

The respirator program administrator is responsible for establishing a training program in compliance with the OSHA Respiratory Protection Standard [29 CFR 1910.134]. Employees should be trained on the following aspects:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protection of the respirator;
- What the limitations and capabilities of the respirator are;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- How to inspect, put on and remove, use, and check the seals of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators

- Unique CBRN SCBA user instructions and locations of CBRN NIOSH label confirming CBRN approval of the CBRN SCBA or upgraded SCBA to CBRN protection.

11) **Is it necessary to wear a protective suit ensemble or protective clothing in conjunction with a CBRN SCBA?**

Some CBRN contaminants produce toxic effects by contact with the skin and these effects can be immediate or delayed depending on the type of contaminant. NIOSH has issued Caution and Limitation 'Q' for the CBRN SCBA stating:

"Q Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazards."

Although CBRN SCBA are approved by NIOSH as stand alone respiratory protection devices and not in tandem with a protective suit ensemble or other type of protective clothing, this statement advises users that an appropriate level of protective clothing should be worn with the CBRN SCBA based on the need for dermal protection against CBRN hazards.

CBRN SCBA are designed by manufacturers to be compatible with various levels of protective clothing, including encapsulating suits (those which completely enclose the wearer's entire SCBA) and non-encapsulating protective suits (suits which partially enclose or cover the SCBA). The type of protective clothing or protective suit ensemble must be based on dermal protection needed for the identified type of CBRN hazard. The user must be outfitted with an appropriate protective ensemble or protective suit to protect against skin absorption. The selection of the protective ensembles must relate to recognized definitions of the types of ensembles that can be used for CBRN incidents. It is not the intention to use the certified CBRN SCBA for multiple incidents however; it may be possible to reenter specific CBRN incidents following a quick gross decontamination and clean replenishment of air supply. If the protective suit is compromised and a non-CBRN approved SCBA is worn instead of a CBRN approved SCBA, the interior of the suit becomes a confined space allowing for agent to attack the dermal areas and respiratory system. Chemical warfare agents most predominate route of entry is the respiratory system. Adequate protection provided by a NIOSH approved CBRN SCBA will ensure minimum respiratory protection is provided even if the suit is compromised. This protective quality may offer just enough time for the wearer to escape contamination and go to a less contaminated area for immediate decontamination. A properly maintained and donned

NIOSH CBRN SCBA provides the highest level of respiratory protection available to Level A or Level B outfitted responders.

12) **Will wearing a protective suit ensemble protect my CBRN SCBA from becoming contaminated?**

Only protective clothing ensembles designed to enclose an SCBA within an encapsulating suit, those which completely enclose the wearer's entire SCBA, or non-encapsulating suit, suits which enclose but are not vapor tight, will provide a level of protection for the SCBA hardware to prevent or reduce exposure of the SCBA to contamination. The protective clothing ensembles that expose the CBRN SCBA visor and second stage regulator to ambient toxic concentrations should be limited to vapor exposure only. Liquid exposures should require full Level A encapsulation to protect the entire responder and SCBA. Next generation of improved Level A ensembles or variations of that ensemble are incorporating unique respirator to suit interfaces that bridge the gap that chemical tape does now.

EPA Level A and B defined levels of personal protection utilize SCBA and specific protective suit ensembles with accessories. EPA Level A suit ensembles are vapor, aerosol, solid, liquid and gaseous protective against known specific industrial agents. NIOSH CBRN Approvals do not exist for EPA Level A, B, C or D protective suit ensembles. NFPA compliance testing of given protective ensembles is occurring and is expected to provide a level of CBRN protection under a given laboratory condition. EPA Level B suit ensembles are liquid-tight and provide protection from liquid splashes but do not protect against chemical vapors or gases. NIOSH recognizes that the protection provided by a Level A or Level B encapsulated suit will likely prevent CBRN contamination from contacting a NIOSH CBRN SCBA depending on the physical state of the CWA (liquid or gas/vapor state) and the corresponding Level A or B suit but currently does not issue approvals to that effect. In these instances where the appropriate level of encapsulated suit is used corresponding to the physical state of the CWA, the limitation of 6 continuous hours of use from the time of initial chemical warfare agent (CWA) exposure would not apply until the suit is compromised or the CBRN SCBA is inadvertently or deliberately exposed to CWA contamination as a result of doffing, fair wear and tear or direct or collateral physical or puncture damage.

For Level B ensembles which are non-encapsulating, the CBRN SCBA head harness must be on the inside of the ensemble and not be directly exposed to ambient hazards. If the head harness is worn over the protective hood, the fit test sealing properties will most likely not be replicated or the facepiece will have to be tightened

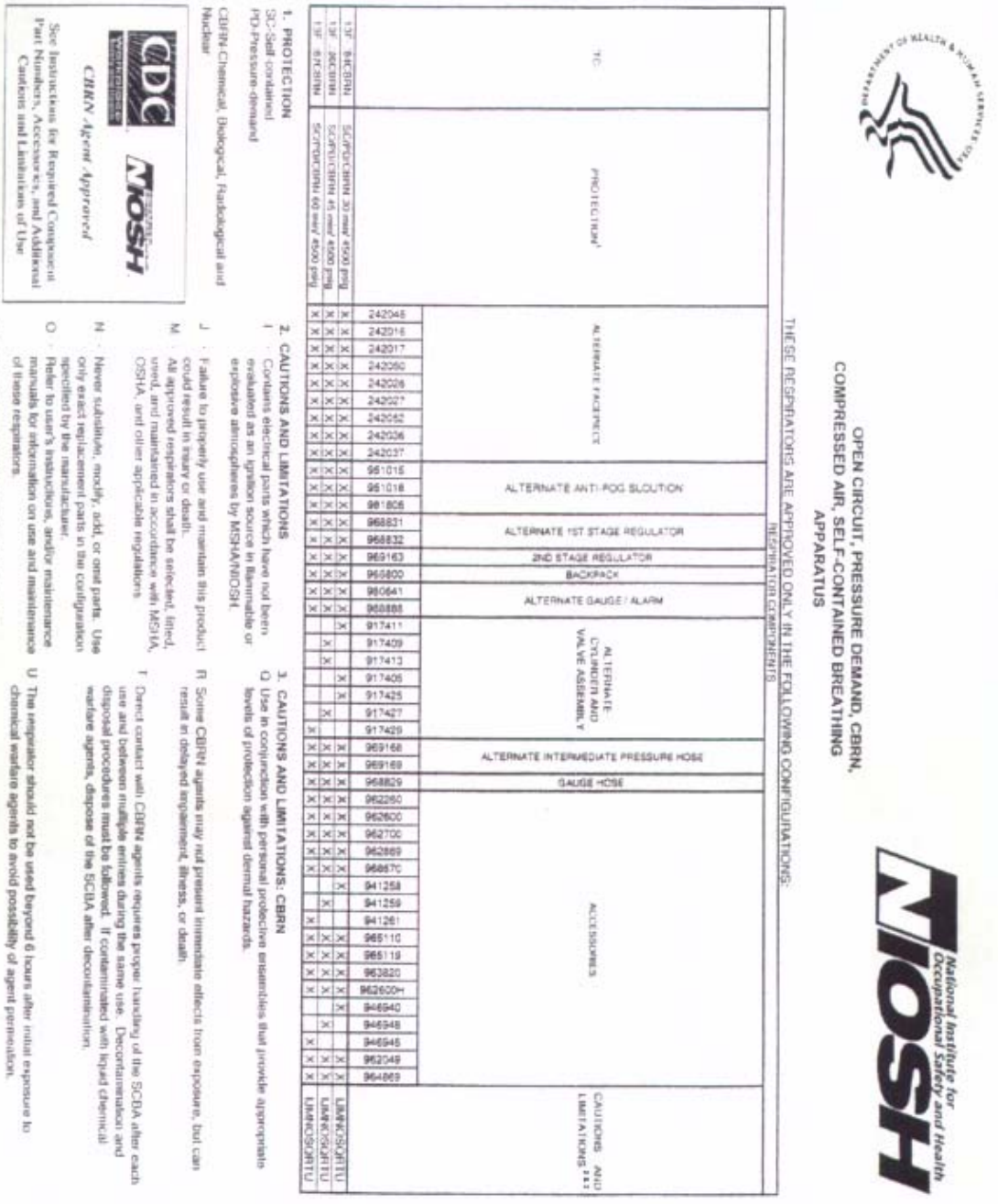
excessively to attain a proper seal. While this process may seam to bridge the suit to respirator interface gap, it does not allow the suit to fully protect the head area and may compromise the sealing properties of the respirator facepiece. Those SCBA components exposed to the environment, such as the lens of the facepiece, should be considered contaminated if used in a CWA agent environment, and for those components, the 6 hour use limitation will apply. In the case of protection against chemical warfare agents, not all chemical protective suits are tested and rated protective against chemical warfare agents. A suit ensemble which has been tested to proved protection against CWA must be used if CWA protection is required.

13) **How do I determine my fire department 'non-CBRN' NIOSH approved SCBA can be upgraded to NIOSH CBRN approved protection?**

Contact the manufacturer. Visit the NIOSH NPPTL website to locate the model of SCBA in use and whether it has a NIOSH approved CBRN Upgrade/Retrofit Kit available. Select models of previously deployed traditional 'non-CBRN' NIOSH approved SCBA can be upgraded for protection against CBRN agents using procedures and materials designated by NIOSH. The best source of help for this question is to contact the respirator manufacturer of the currently deployed traditional industrial unit to determine if it is capable of being upgraded. A manufacturer's representative may need to physically inspect the unit to determine if it is a model that is capable of being upgraded to CBRN protection status. Only NFPA 1981, editions 1997 and 2002 have NIOSH approved CBRN SCBA Upgrade Kits approved and in production. The CBRN SCBA upgrade procedure involves accurate configuration management, identification of field deployed SCBA that are eligible for upgrade, the installing of specific new parts, inspection, testing, re-installation of defective components found during inspection, adding new CBRN Retrofit labels and instructions. This CBRN SCBA Upgrade approval signifies that the products receiving the upgrade are expected to protect firefighters and other emergency responders from CBRN-related gaseous, airborne particulate, and liquid respiratory exposures. NIOSH based its determination on positive results from rigorous laboratory tests, evaluation of product specifications for the upgrade procedures, materials, and an assessment of the manufacturer's quality control procedures. A bill of materials identifying the various models of SCBA eligible for CBRN SCBA upgrades is available from the manufacturer. CBRN SCBA upgrade of a SCBA should not be done by untrained or unauthorized personnel. Contact the SCBA manufacturer for specific CBRN SCBA upgrade programs available.

Appendix C: NIOSH Use Guide CBRN SCBA Example Approval Label

The following items are integral to configuration management of NIOSH CBRN SCBA. They are the NIOSH Approval Letter, the NIOSH approved parts list, known as an 'assembly matrix', the NIOSH exploded view drawing, the NIOSH test results, the NIOSH adhesive labels on the harness assembly, and the CBRN approval labels and CBRN Retrofit approval label. The below example is a variable replica of an actual CBRN SCBA approved paper insert label that is required to be in the user instructions of the CBRN SCBA.



OPEN CIRCUIT, PRESSURE DEMAND, CBRN, COMPRESSED AIR, SELF-CONTAINED BREATHING APPARATUS

THESE RESPIRATORS ARE APPROVED ONLY IN THE FOLLOWING CONFIGURATIONS:

RESPIRATOR COMPONENTS

TC	PROTECTION[1]	ALTERNATE FACEPIECE	ALTERNATE ANTI-FOG SOLUTION	ALTERNATE 1ST STAGE REGULATOR	2ND STAGE REGULATOR	BACKPACK	ALTERNATE GAUGE / ALARM	ALTERNATE CYLINDER AND VALVE ASSEMBLY	ALTERNATE INTERMEDIATE PRESSURE HOSE	GAUGE HOSE	ACCESSORIES	CAUTIONS AND LIMITATIONS[2,3]
13F - 84CBRN	SCUPERCBRN 60 min/ 4500 psig	242045	961015	968831	969163	968800	968641	917411	969168	968829	962260	UMWKQSQRTU
13F - 85CBRN	SCUPERCBRN 45 min/ 4500 psig	242016	961016	968832			968888	917409	969169		962600	UMWKQSQRTU
13F - 87CBRN	SCUPERCBRN 30 min/ 4500 psig	242017	961806					917413			962700	UMWKQSQRTU
		242050						917406			962869	
		242026						917425			968670	
		242027						917427			941258	
		242052						917429			941259	
		242036									941261	
		242037									965110	
											965119	
											963820	
											962600H	
											946940	
											946948	
											946945	
											962049	
											964869	

1. PROTECTION
SC-Self contained
PD-Pressure-demand
CBRN-Chemical, Biological, Radiological and Nuclear

2. CAUTIONS AND LIMITATIONS
I - Contains electrical parts which have not been evaluated as an ignition source in flammable or explosive atmospheres by MSHA/NIOSH.
J - Failure to properly use and maintain this product could result in injury or death.
M - All approved respirators shall be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.
N - Never substitute, modify, add, or omit parts. Use only exact replacement parts in the configuration specified by the manufacturer.
O - Refer to user's instructions, and/or maintenance manuals for information on use and maintenance of these respirators.
S - Special or critical user's instructions and/or specific use limitations apply. Refer to user's instructions before donning.

3. CAUTIONS AND LIMITATIONS: CBRN
Q Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazards.
R Some CBRN agents may not present immediate effects from exposure, but can result in delayed impairment, illness, or death.
T Direct contact with CBRN agents requires proper handling of the SCBA after each use and between multiple entries during the same use. Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, dispose of the SCBA after decontamination.
U The respirator should not be used beyond 6 hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation.

CDC NIOSH

CBRN Agent Approved

See Instructions for Required Components, Part Numbers, Accessories, and Additional Cautions and Limitations of Use

NIOSH National Institute for Occupational Safety and Health

Appendix D: NIOSH CBRN SCBA User Guidance Checklist

1. Are CBRN SCBA available for all responders, select few or none?

2. Are CBRN SCBA available from mutual aid departments?

3. Do actual responders have basic and advanced WMD awareness training prior to entering an unknown situation with SCBA or CBRN SCBA?

4. Are "First-Due" units fully outfitted with CBRN SCBA, partially or not at all?

5. Are the drivers of incoming responder vehicles trained to drive with CBRN SCBA or other CBRN respirators donned?

6. Are cabins of incoming responder vehicles over-pressurized to maintain a level of protection to passengers in or out of CBRN SCBA? Is ventilation considered?

7. If you have just purchased new or upgraded CBRN SCBA, do you have complete confidence that all unique CBRN protection characteristics of the SCBA have been explained and understood?

8. Are emergency and deliberate entry SOPs updated to include the use of CBRN SCBA?

9. Are provisions in place to supply CBRN approved respirators to initial and triaged casualties?

10. Are on hand Level A protective ensemble pass thru devices compatible with CBRN SCBA?

11. Does local SOP or SOG emphasis proper respirator fit testing, head harness wearing over head instead of on the outside of the hood and training on CBRN SCBA use life?

12. Who is the CBRN SCBA hydrostatic tester?

13. Is the CBRN SCBA fully assembled?

14. Is the CBRN SCBA fully operational?

15. Does the CBRN SCBA show the correct NIOSH CBRN label confirming the system is CBRN approved?

16. Do the part numbers listed on the NIOSH CBRN Label insert located in the user instructions, match the part numbers visible on the CBRN SCBA?

17. Are all manufacturer unique CBRN markings readily known by the wearer?

18. Are all before operations checks complete?

19. Are CBRN SCBA decontamination plans in place?

20. Are CBRN SCBA disposal plans in place?

21. Are CBRN SCBA replacement parts and systems in place?

22. Are CBRN SCBA air compressed cylinders full and in ample supply for cylinder changing out in a clean staging area? Are universal cylinders in use?

23. Is an established CBRN SCBA use life protocol available and capable of being implemented?

24. Are compatible protective ensembles available to provide dermal protection?

25. Are proper handling techniques established and rehearsed on handling contaminated CBRN SCBA after each use or between multiple entries during the same use?

26. Are decontamination and disposal procedures followed as required? Are manufacturers consulted on recommended decontamination procedures?

27. If liquid CBRN agents contaminate the CBRN SCBA, are disposal actions in place to discard the CBRN SCBA after decontamination actions are complete?

28. Is the respirator used beyond 6-hours after initial exposure to chemical warfare agents? If so, confirm no contamination is present. If contamination is present, ensure CBRN SCBA is not used beyond 6-hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation into SCBA materials or breathing zone.

29. Is a CBRN SCBA Upgrade Kit in use? If so, is it fully functional and compatible?

See Appendix E, CBRN SCBA Training Aid, as a separate Excel file attached to this document upon receipt of the file for review.

Appendix G: Bibliography

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